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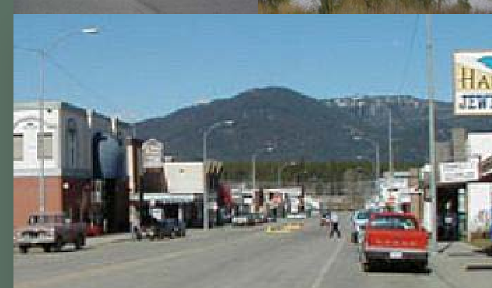
Remedial Investigation Report

Libby, Montana

Operable Unit 5
Libby Asbestos National Priorities List Site

September 2010



EPA United States Environmental Protection Agency

"...to protect human health and to safeguard the natural environment..."

Remedial Investigation Report

Operable Unit 5
Libby Asbestos National Priorities List Site
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September
2010

Prepared for
US Environmental Protection Agency

by

HDR Engineering, Inc.
and
Syracuse Research Corp.

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LIST OF ACRONYMS

ABS	Activity-Based Sampling
AHERA	Asbestos Hazard Emergency Response Act
ATSDR	Agency for Toxic Substances and Disease Registry
bgs	Below ground surface
CE	Cumulative exposure
CFS	Close Support Facility
CSM	Conceptual Site Model
CTE	Central tendency exposures
DQOs	Data quality objectives
EDD’s	Electronic data deliverables
EF	Exposure frequency
EPA	U.S. Environmental Protection Agency
EPC	Exposure point concentration
ERT	Emergency Response Team
ET	Exposure Time
FSDS	Field sample data sheet
GPS	Global Positioning System
HQ	Hazard Quotient
IRIS	Integrated Risk Information System
ISO	International Organization for Standardization
KBPID	Kootenai Business Park Industrial District
LA	Libby Amphibole
LFO	Libby Field Office
LG Site	Libby Groundwater Superfund Site
Libby2DB	Libby 2 Database
LTU	Land Treatment Unit
mg/m^3	milligrams per cubic meter
msl	mean sea level
NAS	National Academy of Sciences Page 32
NMRD	Non-malignant respiratory disease
NPL	National Priority List
OSHA	Occupational Safety and Health Administration
OUs	Operable Units
PAH	Polycyclic aromatic hydrocarbons
PCM	Phase Contrast Microscopy
PCME	Phase Contrast Microscopy Equivalent
PCP	Pentachlorophenol
PLM	Polarized light microscopy
PLM-VE	Polarized Light Microscopy – Visual Estimation
PRP	Potentially responsible parties
RfC	Reference concentration
RI	Remedial Investigation
RME	Reasonable maximum exposures
ROD	Record of Decision

s/cc	Structures per cubic centimeter
s/cm^2	Structures per square centimeter
SAP	Sampling and Analysis Plan
SOPs	Standard operating procedures
SQL	Structured query language
TEM	Transmission electron microscopy
TWF	Time weighting factor
UCL	Upper confidence limit
µm	micrometer

EXECUTIVE SUMMARY

<u>Overview</u>

This Remedial Investigation (RI) Report describes the nature and extent of Libby amphibole (LA) asbestos and associated human health risks at Operable Unit 5 (OU5) of the Libby Asbestos National Priority List (NPL) Site (the Site). LA occurrence throughout the Site resulted from long time mining activities.

Operable Unit 5 is also referred to as the former Stimson Lumber Mill site, as many lumber processing facilities were located throughout OU5. The majority of lumber production activities ceased in 2003 when Stimson Lumber Company sold the property to the Lincoln County Port Authority and ownership was subsequently transferred to the current owner, Kootenai Business Park Industrial District. The OU5 site is currently being redeveloped for a variety of uses, both recreational and industrial. Major site features and land uses are illustrated on Figure ES-1.

Asbestos found at the Libby mine contains a variety of different amphibole types. Because there are presently insufficient toxicological data to distinguish between the different forms, the Environmental Protection Agency (EPA) evaluates all of the mine-related amphibole asbestos types together. This mixture is referred to as LA. Most of the mining operations in Libby were not focused on asbestos, as it was not particularly valuable. However, vermiculite, the main ore extracted and processed at the mine, often contained asbestos and therefore, vermiculite mining acted as a carrier to spread asbestos throughout Libby. Raw vermiculite ore was estimated to contain up to 26% LA (Midwest Research Institute, 1982).

Asbestos exposure in humans may cause both cancer and non-cancer effects. Among them are:

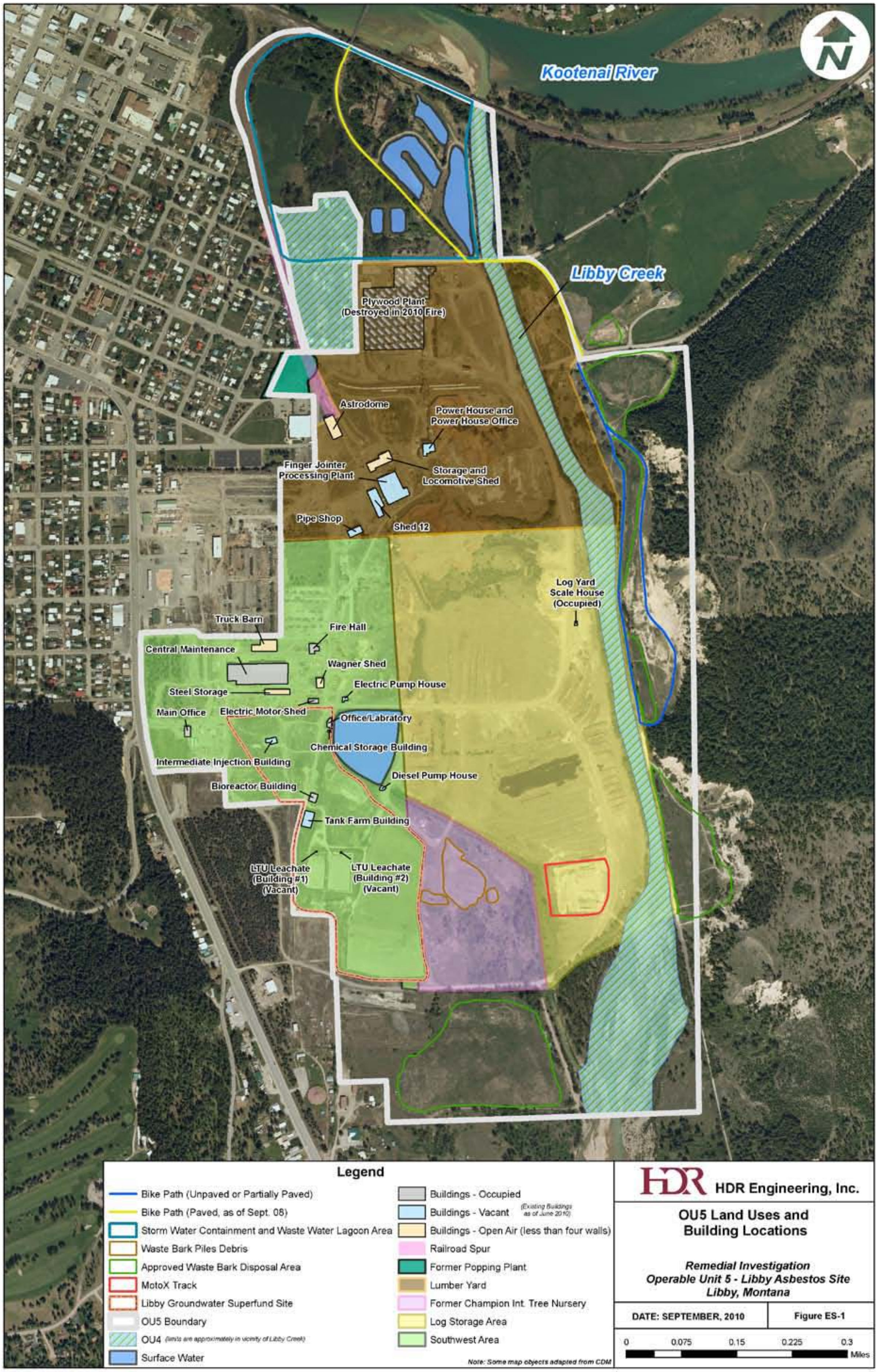
Non-Cancer Effects:

- Asbestosis
- Pleural Abnormalities

Cancer Effects:

- Lung cancer
- Mesothelioma

People who visit or work at OU5 may be exposed to LA by incidental ingestion of contaminated soil or dust and by inhalation of air that contains LA fibers. Of these two pathways, inhalation exposure is considered to be of greatest concern.


Kootenai River
N
Libby Creek
Plywood Plant (Destroyed in 2010 Fire)
Astrodome
Power House and Power House Office
Finger Jointer Processing Plant
Storage and Locomotive Shed
Pipe Shop
Shed 12
Log Yard Scale House (Occupied)
Truck Barn
Fire Hall
Central Maintenance
Wagner Shed
Steel Storage
Electric Pump House
Main Office
Electric Motor Shed
Office/Labratory
Chemical Storage Building
Intermediate Injection Building
Diesel Pump House
Bioreactor Building
Tank Farm Building
LTU Leachate (Building #1) (Vacant)
LTU Leachate (Building #2) (Vacant)
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Bike Path (Paved, as of Sept. 08)
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Approved Waste Bark Disposal Area
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OU5 Boundary
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(Existing Buildings as of June 2010)
Buildings - Open Air (less than four walls)
Railroad Spur
Former Popping Plant
Lumber Yard
Former Champion Int. Tree Nursery
Log Storage Area
Southwest Area
Note: Some map objects adapted from CDM
HDR Engineering, Inc.
OU5 Land Uses and Building Locations
Remedial Investigation
Operable Unit 5 - Libby Asbestos Site
Libby, Montana
DATE: SEPTEMBER, 2010
Figure ES-1
0
0.075
0.15
0.225
0.3
Miles

The amount of LA fibers released to air will vary depending upon the level of LA in the source material (e.g., outdoor soil, indoor dust) and the intensity and duration of the disturbance activity. Because of this, predicting LA levels in air associated with disturbance activities based only on measured LA levels in source material is extremely difficult. Therefore, the most direct way to determine potential exposures from inhalation is to measure, through sample and analysis, the concentration of LA in air during a specific activity that disturbs a source material. For convenience, this is referred to as activity-based sampling (ABS).

Site Investigations

Investigations at OU5 began in May of 2002 and continued through 2009. EPA performed several ABS studies at in 2007 and 2008 to investigate levels of LA in air associated with a variety of activities under current conditions. In addition to the ABS studies, the following additional media-specific sampling was conducted:

- Dust - standing dust samples collected from horizontal surfaces inside buildings.
- Soils
    - Surface – composite and grab samples collected from 0 to 6 inches below ground surface (bgs).
    - Sub-surface – composite and grab samples collected 6 or more inches bgs.
- Waste Bark - material samples from an existing waste pile.

ABS samples from most occupied buildings contained detectable levels of LA. For buildings where LA was detected, the mean concentration varied by a factor of 1,000. LA was detected in seven of the eight outdoor worker ABS areas. The mean LA concentration varied by a factor of 10 across the seven areas where LA was detected. Sampling at the MotoX area included stationary samplers proximal to the location of spectators as well as samplers fixed to the handlebars of dirt bikes. No LA fibers were detected in any air sample.

ABS sampling was conducted separately for paved and unpaved portions of the bike path. On the paved path, a stationary air monitor was also mounted in a trailer attachment to one of the bicycles to characterize potential exposures to a young child being pulled by a parent. Mean LA concentrations for the adult and child are similar.

Of the 87 indoor dust field samples collected, 28 samples had detectable levels of LA. Only four samples had levels of LA above the current EPA removal action level for indoor dust (> 5,000 total LA structures per square centimeter).

Soil samples were examined both visually for vermiculite and by polarized light microscopy (PLM). PLM results are generally non-detect or trace across OU5. The one location where PLM results have consistently been higher (with observed LA levels up to 1%) is the north-central portion of the former Tree Nursery area (Figure ES-1). This location also has elevated visible vermiculite scores.

Of the 19 waste bark samples analyzed, LA was detected in 1 sample analyzed by PLM and 13 samples analyzed by transmission electron microscopy. These results indicate that LA is present but it is not possible to quantify how much LA may be present based on this qualitative method.

Risk Assessment

The risk assessment uses available data to estimate health risks to people who may breathe asbestos in air while working in or visiting OU5, either now or in the future, based on the conditions that currently exist within OU5. The value of the exposure point concentration term is based on measurements of asbestos concentration levels in air.

The methods used to evaluate human health risks from asbestos are in basic accord with EPA guidelines for evaluating risks at Superfund sites, including recent guidance that has been specifically developed to support evaluations of exposure and risk from asbestos.

At present, the EPA is working to derive a reference concentration (RfC) for inhalation exposure to LA, but this value is still under development and is not yet available for use in estimation of Hazard Quotient (HQ) values. Therefore, no quantitative evaluation of non-cancer risk is included in this risk assessment.

EPA has collected sufficient data to allow evaluation of exposure pathways that are thought to be most likely of potential concern in OU5. These pathways are the main focus of the risk assessment and include:

- Exposure of indoor workers to residual LA in indoor air of existing buildings.
- Exposure of outdoor workers to residual LA in outdoor soil.
- Exposure of motorcycle riders and spectators at the MotoX Park (Figure ES-1).
- Exposure of bicycle riders along the recreational trail.

Table ES-1 presents the excess cancer risk estimates for workers exposed to indoor air in each building. As shown, excess cancer risk estimates are within or below EPA's acceptable risk range (1E-04 to 1E-06) for all sampled buildings, indicating that indoor worker exposures at these buildings are likely to be of relatively low concern.

TABLE ES-1
Indoor Worker Exposure Point Concentrations and Risk Calculations

Panel A: CTE

Building Type	Building Name	EPC (PCME LA f/cc) Active	EPC (PCME LA f/cc) Passive	% of Time Active	ET hrs/day	EF days/yr	a yrs	d yrs	TWF --	$IUR_{a,d}$ $(PCM\ f/cc)^{-1}$	Risk
Occupied	CMB, B+C Packaging	2.4E-04	< 4.9E-04	100%	6	180	23	2	0.127	0.010	< 3E-07
	Bioreactor Building	2.3E-04	< 4.9E-04	50%	8	219	20	10	0.200	0.039	< 3E-06
	CDM Main Office[a]	3.2E-03	< 4.9E-04	5%	8	250	35	10	0.228	0.021	< 3E-06
	Central Maintenance Building	2.6E-03	5.3E-04	85%	3	146	33	11	0.049	0.024	3E-06
	Fire Hall	< 6.3E-03	< 4.9E-04	50%	8	219	20	10	0.200	0.039	< 3E-05
	Log Yard Truck Scale House	1.6E-02	< 5.0E-04	100%	0.07	9	29	13	0.000	0.033	< 4E-08
	Luck EG Electric Motor Shed	5.0E-03	< 4.5E-04	100%	0.22	280	35	8	0.007	0.019	< 7E-07
	Office/Laboratory	2.5E-04	< 4.9E-04	50%	8	219	20	10	0.200	0.039	< 3E-06
Vacant	Chemical Storage Building	< 4.9E-04	--	[b]	8	219	20	10	0.200	0.039	< 4E-06
	Diesel Fire Pump House	2.8E-04	--	[b]	8	219	20	10	0.200	0.039	2E-06
	Electric Pump House	8.4E-04	--	[b]	8	219	20	10	0.200	0.039	7E-06
	Intermediate Injection Building	< 4.8E-04	--	[b]	8	219	20	10	0.200	0.039	< 4E-06
	LTU Leachate Building #1	9.7E-05	--	[b]	8	219	20	10	0.200	0.039	8E-07
	LTU Leachate Building #2	< 4.9E-04	--	[b]	8	219	20	10	0.200	0.039	< 4E-06
	Pipe Shop	< 2.2E-03	--	[b]	8	219	20	10	0.200	0.039	< 2E-05
	Power house/office	< 9.1E-04	--	[b]	8	219	20	10	0.200	0.039	< 7E-06
	Shed 12	< 4.9E-04	--	[b]	8	219	20	10	0.200	0.039	< 4E-06
	Tank Farm Building	< 4.9E-04	--	[b]	8	219	20	10	0.200	0.039	< 4E-06

Notes:

[a] Exposure parameters based on CDM Office worker Type 1

[b] Only active ABS data available; risk estimates assume 100% of time is active

CMB = Central Maintenance Building

TABLE ES-1 (Continued)

Indoor Worker Exposure Point Concentrations and Risk Calculations

Panel B: RME

Building Type	Building Name	EPC (PCME LA f/cc)		% of Time	ET	EF	a	d	TWF	$IUR_{a,d}$	Risk
		Active	Passive	Active	hrs/day	days/yr	yrs	yrs	--	(PCM f/cc)$^{-1}$	
Occupied	CMB, B+C Packaging	2.4E-04	< 4.9E-04	100%	7	180	18	5	0.144	0.024	8E-07
	Bioreactor Building	2.3E-04	< 4.9E-04	80%	8	250	20	25	0.228	0.069	< 5E-06
	CDM Main Office	3.2E-03	< 4.9E-04	80%	8	250	20	25	0.228	0.069	< 4E-05
	Central Maintenance Building	2.6E-03	5.3E-04	100%	8	329	17	31	0.315	0.084	7E-05
	Fire Hall	< 6.3E-03	< 4.9E-04	80%	8	250	20	25	0.228	0.069	< 8E-05
	Log Yard Truck Scale House	1.6E-02	< 5.0E-04	100%	0.08	10	20	25	0.000	0.069	< 1E-07
	Luck EG Electric Motor Shed	5.0E-03	< 4.5E-04	100%	0.33	300	21	15	0.011	0.050	< 3E-06
	Office/Laboratory	2.5E-04	< 4.9E-04	80%	8	250	20	25	0.228	0.069	< 5E-06
Vacant	Chemical Storage Building	< 4.9E-04	--	[b]	8	250	20	25	0.228	0.069	< 8E-06
	Diesel Fire Pump House	2.8E-04	--	[b]	8	250	20	25	0.228	0.069	4E-06
	Electric Pump House	8.4E-04	--	[b]	8	250	20	25	0.228	0.069	1E-05
	Intermediate Injection Building	< 4.8E-04	--	[b]	8	250	20	25	0.228	0.069	< 8E-06
	LTU Leachate Building #1	9.7E-05	--	[b]	8	250	20	25	0.228	0.069	2E-06
	LTU Leachate Building #2	< 4.9E-04	--	[b]	8	250	20	25	0.228	0.069	< 8E-06
	Pipe Shop	< 2.2E-03	--	[b]	8	250	20	25	0.228	0.069	< 3E-05
	Power house/office	< 9.1E-04	--	[b]	8	250	20	25	0.228	0.069	< 1E-05
	Shed 12	< 4.9E-04	--	[b]	8	250	20	25	0.228	0.069	< 8E-06
	Tank Farm Building	< 4.9E-04	--	[b]	8	250	20	25	0.228	0.069	< 8E-06

(shaded) Exposure parameters based on site-specific survey results (see Table 7-2)

Notes:

[a] Exposure parameters based on CDM Office worker Type 1

[b] Only active ABS data available; risk estimates assume 100% of time is active

CMB = Central Maintenance Building

Table ES-2 presents excess cancer risk estimates for workers exposed to outdoor air during soil disturbance activities in each ABS area. Because all risk estimates are within or below EPA's target risk range, outdoor worker exposures to asbestos from disturbing soil in these ABS areas are likely to be of relatively low concern.

The Outdoor Worker ABS program specifically targeted an area of OU5 (ABS Area #8) to be representative of a location with the highest expected levels of LA in soils. This and other ABS areas were selected based on a review of existing data on the occurrence of LA and visible vermiculite in surface soils. As seen in Table ES-2, the estimated cancer risks to workers in all ABS areas, including ABS Area #8, are below or within EPA's acceptable risk range. This suggests that other locations with soil contamination levels that are similar to or less than those evaluated as part of the ABS program are also likely to be within EPA's acceptable risk range.

Estimated cancer risks for both MotoX riders and spectators are within or below EPA's acceptable risk range (Table ES-3). These results support the conclusion that inhalation of outdoor air at the MotoX Park is unlikely to be a source of significant excess cancer risk to either MotoX riders or spectators.

Estimated cancer risks for both adults and children who use the recreational path are below EPA's acceptable risk range (Table ES-4). These results support the conclusion that inhalation of outdoor air along the recreational path is unlikely to be a source of significant excess cancer risk.

Estimated cancer risks for workers exposed to outdoor air during waste bark pile disturbance activities are within EPA's acceptable risk range (Table ES-5). These results support the conclusion that inhalation of outdoor air near disturbances of the waste bark piles is unlikely to be a source of significant excess cancer risk to outdoor workers.

Cancer risk estimates based on measured LA concentrations in air (for each human activity separately) are within or below EPA's risk range for indoor and outdoor workers, as well as recreational visitors along the bike path and at the MotoX Park. These results suggest that recreational and occupational exposures are likely to be of low concern. However, it is important to note that most people who visit or work in OU5 are likely to be exposed to LA by a number of different exposure pathways, and that risk management decision-making should consider the sum of the risks across all pathways, not just those evaluated in this report.

An ecological risk assessment is being developed for the mine site (OU3). EPA will build upon the information gathered during that ecological risk assessment to identify potential pathways and receptors to evaluate ecological risk at OU5. If ecological exposure pathways are identified at OU5 an ecological risk assessment will be performed.

TABLE ES-2
Outdoor Worker Exposure Point Concentrations and Risk Calculations for Exposures During Soil Disturbances

Panel A: CTE

ABS Area	EPC PCME LA f/cc	ET hrs/day	EF days/yr	a yrs	d yrs	TWF --	$IUR_{a,d}$ $(PCM\ f/cc)^{-1}$	Risk
1	2.0E-03	4	131	20	10	0.060	0.039	5E-06
2	2.3E-03	4	131	20	10	0.060	0.039	5E-06
3	6.3E-03	4	131	20	10	0.060	0.039	1E-05
4	< 4.3E-03	4	131	20	10	0.060	0.039	< 1E-05
5	1.4E-02	4	131	20	10	0.060	0.039	3E-05
6	2.5E-03	4	131	20	10	0.060	0.039	6E-06
7	1.3E-03	4	131	20	10	0.060	0.039	3E-06
8	3.1E-03	4	131	20	10	0.060	0.039	7E-06
Average	3.9E-03	4	131	20	10	0.060	0.039	< 9E-06

Panel B: RME

ABS Area	EPC PCME LA f/cc	ET hrs/day	EF days/yr	a yrs	d yrs	TWF --	$IUR_{a,d}$ $(PCM\ f/cc)^{-1}$	Risk
1	2.0E-03	4	135	20	25	0.062	0.069	8E-06
2	2.3E-03	4	135	20	25	0.062	0.069	1E-05
3	6.3E-03	4	135	20	25	0.062	0.069	3E-05
4	< 4.3E-03	4	135	20	25	0.062	0.069	< 2E-05
5	1.4E-02	4	135	20	25	0.062	0.069	6E-05
6	2.5E-03	4	135	20	25	0.062	0.069	1E-05
7	1.3E-03	4	135	20	25	0.062	0.069	5E-06
8	3.1E-03	4	135	20	25	0.062	0.069	1E-05
Average	3.9E-03	4	135	20	25	0.062	0.069	< 2E-05

TABLE ES-3
MotoX Exposure Point Concentrations and Risk Calculations

Panel A: CTE

Receptor Type	EPC PCME f/cc	ET hrs/day	EF days/yr	a yrs	d yrs	TWF --	$IUR_{a,d}$ $(PCM\ f/cc)^{-1}$	Risk
Participant	< 0.0098	2	30	25	35	0.007	0.063	< 4E-06
Spectator	< 0.0011	4	30	15	45	0.014	0.11	< 2E-06

Panel B: RME

Receptor Type	EPC PCME f/cc	ET hrs/day	EF days/yr	a yrs	d yrs	TWF --	$IUR_{a,d}$ $(PCM\ f/cc)^{-1}$	Risk
Participant	< 0.0098	4	40	15	55	0.018	0.11	< 2E-05
Spectator	< 0.0011	4	60	15	45	0.027	0.11	< 3E-06

TABLE ES-4
Recreational Visitor Exposure Point Concentrations and Risk Calculations

Panel A: CTE

Receptor	Location	EPC PCME LA f/cc	ET hrs/day	EF days/yr	a yrs	d yrs	TWF unitless	$IUR_{a,d}$ $(PCM\ f/cc)^{-1}$	Risk
Adult	Unpaved/Paved	9.5E-05	1	24	15	45	0.0027	0.11	3E-08
Child	Trailer (Paved)	1.3E-04	1	24	0.5	6	0.0027	0.05	2E-08

Panel B: RME

Receptor	Location	EPC PCME LA f/cc	ET hrs/day	EF days/yr	a yrs	d yrs	TWF unitless	$IUR_{a,d}$ $(PCM\ f/cc)^{-1}$	Risk
Adult	Unpaved/Paved	9.5E-05	2	48	15	45	0.011	0.11	1E-07
Child	Trailer (Paved)	1.3E-04	2	48	0.5	6	0.011	0.05	8E-08

Table ES-5
Outdoor Worker Exposure Point Concentrations and Risk Calculations
for Exposures During Waste Bark Pile Disturbances

Panel A: CTE

EPC PCME f/cc	ET hrs/day	EF days/yr	a yrs	d yrs	TWF --	$IUR_{a,d}$ $(PCM\ f/cc)^{-1}$	Risk
< 0.0012	4	131	20	10	0.060	0.04	< 3E-06

Panel B: RME

EPC PCME f/cc	ET hrs/day	EF days/yr	a yrs	d yrs	TWF --	$IUR_{a,d}$ $(PCM\ f/cc)^{-1}$	Risk
< 0.0012	4	135	20	25	0.062	0.07	< 5E-06

1.0 INTRODUCTION

1.1 OVERVIEW AND REPORT ORGANIZATION

This Remedial Investigation (RI) Report describes the nature and extent of Libby amphibole (LA) asbestos and associated human health risks at Operable Unit 5 (OU5) of the Libby Asbestos National Priority List (NPL) Site (the Site). LA occurrence throughout the Site resulted from long time mining activities and the use and handling of materials which contained LA.

U.S. Environmental Protection Agency (EPA) has had a presence in Libby since 1999 and has completed a number of sampling activities and removal efforts. EPA determined there was imminent and substantial endangerment to public health from asbestos contamination in various types of source materials in and around Libby.

In light of evidence of human asbestos exposure and associated increase in health risks, it was recommended that EPA take appropriate steps to reduce or eliminate exposure pathways to these materials to protect area residents and workers. In 2002, Libby was classified as a NPL Site which, due to its large size, has been divided into eight Operable Units (OUs):

- OU1 – Former Export Plant
- OU2 – Former Screening Plant
- OU3 – Mine Site
- OU4 – Residential and commercial properties in and around Libby
- OU5 – Former Stimson Lumber Mill
- OU6 – Rail Line
- OU7 – Residential and commercial properties in and around Troy
- OU8 – US and Montana State highways and secondary highways in the vicinity of Libby and Troy, Montana.

Figure 1-1 presents a map showing the entire NPL area and boundaries of all OUs. This RI addresses OU5, which is located south of the incorporated limits of Libby and contains the former Stimson Lumber Mill and all properties owned by Kootenai Business Park Industrial District (KBPID). The OU5 boundary also encompasses the unrelated Libby Groundwater Superfund Site (LG Site), which has been on the NPL since September 1983 due to groundwater contamination resulting from wood preservative processing (Figure 1-2). While the LG Site is separate from LA investigations described in this RI, the land surface within the LG Site was sampled as part of the OU5 investigation. In addition, air samples were taken at buildings within the LG Site.

Libby Creek (which is part of OU4) traverses the western portion of OU5, but is not part of OU5. Therefore, it will not be discussed in this report.

An ecological risk assessment is being developed for the mine site (OU3). EPA will build upon information gathered during that ecological risk assessment to identify potential pathways and receptors to evaluate ecological risk at OU5. If ecological exposure pathways are identified at OU5 an ecological risk assessment will be performed.

The RI Report is organized into the following major sections:

Section 1 – Introduction – This section describes the purpose of the RI and summarizes prior work and NPL Site history.

Section 2 – Site Characteristics – This section provides a brief description of Site setting, climate, geology, hydrogeology, and surface water hydrology.

Section 3 – Sampling and Analyses – This section discusses sample types and collection methods and analytical techniques.

Section 4 – Data Recording, Data Quality Assessment, and Data Selection – This section discusses the Libby database, quality control measures and how data were selected to produce the final OU5 data set used to describe the nature and extent of contamination and for calculation of health risk estimates.

Section 5 – Nature and Extent of Contamination – This section provides a description of the current type and extent of LA in surface and subsurface soils, indoor and outdoor air and bulk materials. In addition, a brief discussion of groundwater conditions is provided associated with the LG Site underlying portions of OU5.

Section 6 – Contaminant Fate and Transport – This section provides a qualitative discussion of LA contaminant migration routes and persistence in the environment.

Section 7 – Baseline Risk Assessment – This section presents the human health risk assessment.

Section 8 – Conclusions – This section presents general conclusions.

Section 9 – References – This section provides full references for all citations in the body of the report.

1.2 NPL SITE LOCATION & TOPOGRAPHY

The City of Libby, Montana is located in the northwest corner of the state, 35 miles east of Idaho and 65 miles south of the Canadian border (Figure 1-1). It is at an elevation of approximately 2,580 feet above mean sea level (msl). The source of LA, Vermiculite Mountain, is located approximately 7 miles northwest of Libby. The city has a total area of 1.3 square miles and lies in a valley carved by the Kootenai River and bounded by the Cabinet Mountains to the south.

The OU5 site is relatively flat and slopes slightly towards the north north-east. It encompasses approximately 400 acres and includes a number of commercial and industrial buildings as well as areas used for recreation.

1.3 NPL SITE HISTORY

Libby is located near a large open-pit vermiculite mine on Vermiculite Mountain. Vermiculite is mica-like mineral that can be processed for use as an insulating material or soil amendment and has been mined in Libby since 1919. It is estimated that the Libby mine was the source of over 70 percent of all vermiculite sold in the U.S. from 1919 to 1990. Over its lifetime, it employed more than 1,900 people. W. R. Grace bought the mine and processing facility in 1963 and operated it until 1990 (EPA, 2010a)

Vermiculite from this mine contains varying levels of amphibole asbestos, consisting primarily of winchite and richterite, with lower levels of tremolite, magnesioriebeckite, and possibly actinolite. Because existing toxicological data are not sufficient to distinguish differences in toxicity among these different forms, EPA does not believe that it is important to attempt to distinguish among these various amphibole types. Therefore, EPA simply refers to the mixture as Libby amphibole (LA) asbestos. Historic mining, milling, and processing operations as well as bulk transfer of mining-related materials, tailings, and waste to locations throughout Libby Valley, are known to have resulted in releases of vermiculite and LA to the environment. This has caused a range of adverse health effects in exposed people, including individuals who did not work at the mine or processing facilities

EPA has been working in Libby since 1999 when an Emergency Response Team was sent to investigate local concern and news articles about asbestos-contaminated vermiculite. Since that time, EPA has been working closely with the community to clean up contamination and reduce risks to human health.

Based on health risks associated with asbestos, which include asbestosis, lung cancer and mesothelioma, EPA placed the Libby Asbestos Site on the NPL in October 2002.

Libby, Montana, which is the Lincoln County seat, has a population of less than 3,000, and 12,000 people live within a ten-mile radius. While Libby’s economy is still largely supported by natural resources such as logging and mining, there are also many tourist and recreational opportunities in the area.

1.4 OU5 HISTORY AND DESCRIPTION

Operable Unit 5 is also referred to as the former Stimson Lumber Mill site, as many lumber processing facilities were located throughout. The J. Neils Lumber Company began wood treating operations at OU5 in approximately 1946. The lumber company and wood treating operation was purchased by St. Regis Corporation in 1957. Champion International Corporation purchased the facility in 1985 who then sold it to Stimson Lumber Company in 1993.

The majority of lumber production activities ceased in 2003 when Stimson Lumber Company sold the property to the Lincoln County Port Authority and ownership was subsequently transferred to the current owner, KBPID. The Site is currently being redeveloped for a variety of uses, both recreational and industrial.

Figure 1-3 shows former and current land uses and buildings throughout the Site that existed in June 2010. One of the largest structures at OU5, the Plywood Plant, was entirely destroyed by fire in early 2010.

During Site interviews conducted in 2001, three specific outdoor subareas of interest were identified (CDM, 2007a) due to potential vermiculite (and associated LA) contamination concerns (Figure 1-3):

- The former Popping Plant was once used as an aboveground storage area for uncontained vermiculite ore. Ore was stockpiled directly on the native soil surface in this area.
- The Railroad Spur was used for shipping raw and unprocessed vermiculite material to and from OU5.
- The former Tree Nursery may have introduced raw vermiculite product into this area as a growth medium and fill material.

Additionally, waste bark piles remain from historical lumber processing activities at OU5.

Under current conditions, OU5 is used mainly for commercial/industrial purposes. Portions of the Site are used for recreational purposes. This includes an area that has been developed as a Moto-Cross (MotoX) Park for dirt biking riding, and a trail along Libby Creek that is popular for hiking and bicycle riding. Most of these features are illustrated on Figure 1-3.

Currently, there is no residential land use on OU5. However, a residential area (part of OU4) lies within the OU5 boundaries as shown on Figure 1-3. In addition, residential neighborhoods surround OU5 to the west and northwest.

Redevelopment plans are currently being formulated for OU5. The Kootenai River Development Counsel was recently awarded a grant to upgrade the rail lines and electrical system throughout the Site. Plans have also discussed development of a walking path and fishing pond in the northeast corner of the Site near Libby Creek.

Limited tree and grass plant species are located within OU5, primarily along the northern boundary and surrounding Libby Creek. The majority of OU5 is un-vegetated (CDM, 2009a) and suitable for industrial/commercial development.

1.5 REGULATORY HISTORY

The following is a brief chronological summary of major regulatory actions taken at the Site.

- 1999 – Local concern alerts EPA to investigate asbestos in and around Libby, Montana
- 2002 – Libby Asbestos Site proposed for the NPL
- 2002 – Libby Asbestos Site formally added to the NPL
- 1999 through 2009 – Response actions taken to remove asbestos and vermiculite containing material throughout OU5 (Table 1-1)

EPA has not entered into any enforcement agreements or issued any orders for investigation, removal, or remedial work at any part of OU5. The Stimson Lumber Company removed some loose and accessible vermiculite insulation in 2002 and 2003. EPA contractors have taken samples at OU5 many times beginning in 2002. EPA removed vermiculite insulation from a portion of the roof and walls at the Central Maintenance Building in 2005 and contamination from surface soils in 2009. None of these actions was pursuant to any enforcement agreement or order. EPA entered into a site wide settlement with the only Potentially Responsible Party (PRP) for OU5, W. R. Grace, in 2008. That agreement provided for a cash settlement of past and future response costs for the entire Libby NPL Site except OU3, the mine site.

1.6 PREVIOUS RESPONSE ACTIONS AT OU5

EPA established a program to inspect all properties in Libby. The emergency response work in Libby has focused on removing as many LA source areas as possible from all OUs. As of April of 2009, EPA has safely removed over 600,000 cubic yards of asbestos-contaminated waste from major source areas and structures throughout the City of Libby. Contaminated soils are transported to the former Libby Mine site and contaminated construction debris is placed in a specially designed landfill cell. These disposal sites are secured and will remain off-limits to human contact. Recent response efforts have focused on residences and businesses. Currently, the EPA is transitioning from emergency removal activity to the Remedial Process (EPA, 2010a).

In an effort to determine the extent of LA occurrence at OU5, there have been multiple sampling investigations conducted since 2002. These investigations are discussed in detail in Sections 3 and 5 of this report. A number of response actions have been completed to date and are summarized in Table 1-1. Those buildings and land areas subjected to prior response actions that remain at OU5 are illustrated on Figure 1-4.

As shown on Table 1-1, most actions have been performed by asbestos abatement companies privately contracted by Stimson Lumber Company and have focused on removal/containment of asbestos materials in OU5 buildings. EPA directed the removal action at the Central Maintenance Building.

The only known source of residual indoor vermiculite is at the Central Maintenance Building, where remnants of vermiculite insulation remain in wall cavities (CDM, 2007a). However, the possibility exists for residual vermiculite to be present in other OU5 buildings.

Beginning in October 2006, EPA implemented the Environmental Resource Specialist (ERS) program for the entire Libby Superfund Site, including OU5. This program was set up to assist with unplanned and urgent exposures to vermiculite attic insulation due to its association with LA. The ERS program provides a full-time service where property owners, firemen, and other affected personnel or citizens can obtain access to LA expertise outside the normal course of scheduled clean-up actions. The ERS program currently responds to reports of residual vermiculite in OU5 buildings.

In addition to addressing vermiculite (and associated LA) in buildings, EPA performed other response actions including two involving OU5 soils and a third that may have impacted OU5 soils (Figure 1-4):

- OU5 Redevelopment Area – Soil characterization and limited soil removal in an area west of the Pipe Shop. A summary of investigative and soil removal work is provided as Appendix A1.

- Central Maintenance Building – Removal of vermiculite-containing building and other materials by vacuum methods, from the edge of the walls and outward approximately 45 feet. A summary of investigative and soil removal work is provided as Appendix A2.

- Libby Creek Remediation Area – Removal and replacement of rip-rap on the east bank of Libby Creek. Libby Creek is a part of OU4 as it traverses OU5. However, a portion of the response action may have encroached onto OU5 on the east bank of the creek. A summary of investigative and soil removal work is provided as Appendix A3.

In addition, EPA installed a chain-link fence to isolate the former Tree Nursery area (CDM, 2007a).

1.7 PREVIOUS INVESTIGATIONS & REPORTS

Numerous reports have been published dating back to 2007 that describe Site characteristics, as well as conditions on the entire NPL site. Many reports are considered relevant to the OU5 RI and are listed by primary subject as follows:

<u>Sampling and Analysis Plans</u>

- *Sampling and Analysis Plan, Building Data Gap Sample Collection, CDM, Final – 11/2/07*
- *Sampling and Analysis Plan, Initial Soils Data Gap Sample Collection, CDM, Final – 9/10/07*

- *Sampling and Analysis Plan Addendum - Initial Soils Data Gap Sample Collection, Visual Vermiculite Inspection, CDM, Final – 6/13/08*
- *Sampling and Analysis Plan for the MotoX, U.S. Department of Transportation, Final – 8/19/08*
- *Sampling and Analysis Plan for Outdoor Worker Exposures, Syracuse Research Corp., Final – 9/8/08*
- *Sampling and Analysis Plan for Recreational User Exposures, Syracuse Research Corp., Final – 9/8/08*
- *OU5 Activity Based Sampling, Soil Pilot Study (Modification to MotoX ABS SAP & Outdoor Worker ABS SAP), CDM, Rev 1 – 11/28/09*

Sampling Investigation Results Reports

- *Data Summary Report, CDM, Final – 9/10/07*
- *Sampling Summary Report – 2007 Investigations, CDM, Final – 7/25/08*

1.8 LIBBY GROUNDWATER SITE

The LG Site lies within the OU5 boundary but is otherwise, unrelated to OU5 (Figure 1-2). A brief chronology and description of the LG Site history is provided below:

- In 1979, contamination was discovered in a nearby residential drinking water well. Contaminants include creosote, PCP (pentachlorophenol), and PAH's (polycyclic aromatic hydrocarbons).
- LG Site added to the NPL on September 8, 1983. It has two designated OUs:
  - LG-OU1 consists of the alternative drinking water supply initiative sponsored by Champion (a PRP) for the affected and potentially-affected residents of Libby.
  - LG-OU2 consists of affected environmental media including contaminated soils, and groundwater in the upper and lower aquifer.
- LG-OU1 ROD was finalized on September 26, 1986. The remedy included:
  - Champion's Buy Water Plan in which Libby residents were provided monetary compensation for using municipal water supply for irrigation and drinking water instead of contaminated private water wells.
  - An ordinance preventing installation of new water wells for human consumption or irrigation in the upper and lower aquifer within the "corporate limits" for the City of Libby.
- LG-OU2 ROD was finalized on December 30, 1988. The remedy included but is not limited to:
  - Excavation of contaminated soils from identified source areas and placement within a waste pit to undergo a two-step enhanced biodegradation process. The solids were transferred to a land treatment unit, which ultimately will be capped with low permeability materials.

- Insertion of language into the current registered deed identifying locations of hazardous substances disposal and treatment areas, and land use restriction of these areas.
- Oil recovery wells to collect highly-contaminated ground water, which is treated in a fixed film bioreactor prior to reinjection.
- In-situ enhanced biorestoration of upper aquifer ground water.
- Monitoring activities to assess performance of remedy components throughout the life of remedial activities.

Four 5-year reviews have been performed at the LG Site, with the most recent signed on March 5, 2010. The review found the current remedies for LG-OU1 and LG-OU2 to not be protective. The remedy for LG-OU2 does not include institutional controls on a portion of the contaminated groundwater plume. The remedy for LG-OU2 does not currently meet risk-based cleanup levels. Environmental clean-up activities at the LG Site will continue into the future.

2.0 SITE CHARACTERISTICS

2.1 CLIMATE

Annual average precipitation in Libby is 24.7 inches, with an annual average of 105 inches of snowfall (WRCC, 2010). Precipitation and humidity in Libby are greatest during the winter months due to the presence of temperature-regulating Pacific air masses. In December and January, average temperatures range between 25-30 ºF. Occasionally, dry continental air masses occupy the Libby area for short periods of time during the winter, creating cold and less-humid conditions (CDM, 2009a).

Fog is common in Libby during winter months and in early morning throughout the year. Summer months are dryer and warm with occasional rainfall. The average July temperature ranges between 56-70 ºF, with an average high of 80 ºF (CDM, 2009a).

Prevailing winds are from the west north-west and average approximately 6-7 miles per hour. Wind direction and velocities fluctuate depending on temperature variances caused by vertical relief in the area. Inversions often trap stagnant air in the Libby valley (CDM, 2009a).

2.2 GEOLOGY

Regional geology in the Libby valley is comprised of lacustrine deposits underlain by Precambrian rocks. Surrounding mountains are formed by Precambrian rocks. Cliffs along the lower portion of the valley are formed by glacial lake bed deposits. The Kootenai River and Libby Creek cut through lacustrine and alluvial deposits and form a discontinuous sequence of gravel, sand, silt, and clay (EPA, 2010b).

Alluvial deposits extend from the surface to 190 feet (ft) below ground surface (bgs) and are comprised of sand, gravel, silt, clay and cobbles. Glacial till, which consist primarily of silt and clay with varying amounts of sand and gravel underlies alluvial deposits. Deposits of glacial till are believed to be quite deep, occurring at depths exceeding 500 ft bgs (EPA, 2010b).

Soils in the Libby area typically are loamy soil composed of sand and silt with minor amounts of clay. Soil was formed by erosion of pre-Cambrian rocks, downstream transport of clays with rivers and creeks, and organic matter from historically forested areas (CDM, 2009a).

Site soils are a combination of historical soil modified in areas by human activities. These activities may include addition of vermiculite as a soil amendment, soil reworking for building construction, road and railroad operation, vermiculite processing and transport, and general site work.

2.3 HYDROLOGY AND HYDROGEOLOGY

Libby Creek (which is part of OU4) runs through the western portion of OU5 and terminates in the Kootenai River, which flows just outside the northern OU5 border. The Kootenai River originates in British Columbia, Canada, and flows through Montana and Idaho before returning to Canada and flowing into the Columbia River. Flows in the Kootenai River and Libby Creek are tied to runoff from the mountains surrounding Libby. Runoff peaks in spring when high-elevation snow begins to melt. Stream flow decreases in summer due to low precipitation and snowmelt flow moderation by high elevation lakes (CDM, 2009a).

Beneath OU5, saturated alluvial deposits extending from the surface to approximately 190 ft bgs have been sorted into three classifications: upper aquifer, intermediate zone, and lower aquifer. The upper aquifer contains high hydraulic conductivity material including silty gravel and sand with occasional interbedded clayey, silty deposits. It is unconfined and extends from the water table (5 to 30 ft bgs) to approximately 70 ft bgs. Hydraulic conductivity ranges from 100 to 1000 foot per day (ft/day). The inferred groundwater flow direction is north-northwest towards the Kooteni River (EPA, 2010b).

The intermediate zone is comprised of low permeability deposits similar to the upper aquifer, but with a higher percentage of fine-grained material. Acting as a confining layer, the intermediate zone is 40 to 60 ft thick, extending from approximately 60-70 ft bgs to 110 ft bgs. The hydraulic conductivity of this layer is much lower than the upper aquifer at approximately 1 ft/day.

The lower aquifer extends from approximately 100 ft bgs to 190 ft bgs, and contains more low-permeability silt and clay layers than the upper aquifer. It is confined and under pressure, so water in wells screened in this aquifer rise to 14-26 ft bgs. Hydraulic conductivity of the lower aquifer ranges from 50 to 200 ft/day. The inferred groundwater flow direction is north-northwest towards the Kooteni River (EPA, 2010b).

3.0 SAMPLING AND ANALYSIS

Investigations at OU5 began in May of 2002 and continued through 2009. Table 3-1 summarizes sampling events that occurred at OU5 over the seven-year sampling period.

The following sections describe sample types, sample collection and analytical methods. All sample media and associated analytical results are discussed in this Section. However, certain data are excluded from the discussion of nature and extent of LA occurrence (Section 4) including:

- Air, bulk material or other samples associated with a building/structure that has since been demolished or otherwise destroyed or has been cleaned under a removal action.

- Certain other data that was deemed irrelevant to the assessment of risk to human health. These include certain indoor dust and outdoor ambient air samples.

This was done to simplify and focus the description of nature and extent of LA occurrence to those measurements most relevant to the estimation of human health risks.

3.1 SAMPLE TYPES AND COLLECTION PROCEDURES

As shown in Table 3-1, the following media-specific sampling was conducted:

- Air
    - Personal air samples – collected using a sampling pump and filter located in the breathing zone of an individual while performing various activities indoors or outdoors.
    - Stationary air samples – collected using a stationary sampling pump and filter placed either indoors or outdoors.
- Dust - standing dust samples collected from horizontal surfaces inside buildings.
- Soils
    - Surface – composite and grab samples collected from 0 to 6 inches bgs.
    - Sub-surface – composite and grab samples collected 6 or more inches bgs.
- Waste Bark - material samples from existing waste pile shown on Figure 1-3.

Samples were collected, documented, and handled in accord with standard operating procedures (SOPs) as specified in the respective Sampling and Analysis Plans (SAPs). The Data Summary Report and Sampling Summary Report (CDM, 2007a and CDM, 2008) provide additional details on sampling events as well as deviations from the SAPs.

Data documenting sample type, location, collection method, and collection date were recorded both in a field log book maintained by the field sampling team and on a field sample data sheet (FSDS) designed to facilitate data entry into the Libby site database, as described in Section 4.1.

All samples collected in the field were maintained under chain of custody during sample handling, preparation, shipment, and analysis.

3.1.1 Air Samples

All air samples were collected by drawing a sample through a filter that traps asbestos and other particulate material on the face of the filter. Two main categories of air samples were collected:

1. Personal Air Samples - Sampling equipment worn by a person or affixed to a piece of operating equipment/vehicle. Samples collected both indoors and outdoors.

2. Stationary Air Samples - Sampling equipment placed on motionless surface. Samples collected both indoors and outdoors.

Personal air sampling involved a variety of activities performed by the sampler with and without operating equipment/vehicle. These activities may have been scripted or unscripted. Scripted activities required the sampler and/or equipment to perform a written script. Unscripted activities are those for which a formal written script was not used. For example; a scripted activity might involve a sampler performing specific office work routine while wearing a sampling pump and filter cassette in a building with current use as an office. An unscripted activity might involve the sample equipment worn by a site worker going about his/her self-determined routine.

Unscripted personal air data was most frequently collected in association with Occupational Safety and Health Administration (OSHA) exposure monitoring for workers on OU5. These data were not intended for use in site characterization or for estimation of residual risks to current or future populations at OU5.

Stationary sampling included sampling of ambient air at OU5 but also included sampling proximal to a person or piece of equipment conducting scripted activities. Scripted stationary air samples were collected to represent conditions in the breathing zone as a surrogate for a personal air sample.

Such sampling was conducted at a variety of locations including but not limited to:

- Unoccupied buildings while disturbing the dust with a leaf-blower or equivalent.
- Proximal to stadium seating at the MotoX Park during a race.

As discussed in Section 7, inhalation of air is considered to be the most direct route of exposure to LA and is therefore the primary medium of concern. Scripted air sampling activities were determined to provide the most meaningful measure of human exposure to LA at OU5 (EPA, 2008a).

Therefore, data generated from this type of sampling was used to estimate human health risks at OU5 (Section 7). Such scripted sampling is referred to in the remainder of this report as Activity-Based Sampling (ABS).

All ABS events were conducted in accord with EPA's Emergency Response Team (ERT) SOP #2084 (Activity-Based Air Sampling for Asbestos), with project-specific modifications. Activity-Based Sampling was conducted to evaluate possible exposure of a variety of populations at OU5 including commercial/industrial workers, maintenance workers and recreational visitors. Activity-Based Sampling was conducted at locations shown on Figure 3-1 to target the following populations at OU5:

- Visitors participating in and viewing MotoX activities at the MotoX Park (EPA, 2008b)
- Visitors riding a bicycle on the bike path along Libby Creek (EPA, 2008c)
- Workers engaging in outdoor activities at various locations on OU5 (EPA, 2008d; CDM, 2007)
- Workers engaging in indoor activities in various buildings on OU5 (EPA, 2007a)

Activities include raking, operating machinery, riding a bike or motorcycle, moving waste bark and active and passive indoor worker activities. The intent was to disturb LA containing materials (ie. soil or dust) by performing an activity typical for a given building or outdoor location allowing measurement of actual LA exposure for that activity.

A detailed description of the study design and data quality objectives (DQOs) for each ABS study is provided in the respective SAPs, cited above.

As part of the OU5 outdoor worker ABS investigation, sampling was conducted at eight ABS areas (Figure 3-1) (EPA 2008d). Each ABS area was approximately 1-1.5 acres in size. These eight ABS areas were selected based on previous visible vermiculite sampling results to represent the range of expected soil contamination conditions at the OU5 site.

All outdoor ABS air sampling was performed in September or October in order to make measurements during the time of year where conditions are drier than most other months.

3.1.2 Dust Samples

Indoor dust samples were collected as part of four different sampling programs; Phase 1 investigation in May 2002, Contaminant Screening Study in September 2002, Pre-Design Inspection for the Central Maintenance Building in April 2004 (CDM, 2007a), and Building Data Gap Sample Collection (EPA, 2007a).

Dust samples were collected from horizontal surfaces such as a shelf or floor inside buildings. Samples were collected using a microvacuum dust filter that was operated for between two and five minutes. Each sample was a composite consisting of up to ten, 100-square centimeter (cm^2) areas.

These data were primarily used to assess whether an occupied building should be considered for emergency cleanup. As discussed in Section 5.3, several buildings contained dust above the action threshold of 5,000 LA structures per cm^2 (s/cm^2).

As discussed in Section 3.1.1 and 5.2, ABS sampling was conducted in occupied and vacant buildings, including buildings previously subjected to cleaning of interior surfaces and/or removal of LA-containing building materials (e.g. vermiculite insulation). Results of indoor ABS are discussed in Sections 5.2 and 5.3, and associated risk is evaluated in Section 7.

3.1.3 Soil Samples

Surface Soil

Most soil sampling at OU5 involved surface soils. Soil sampling at OU5 began in 2002 with an initial phase that included systematic sampling across most of OU5 as well as a focused investigation of four specific areas of interest including:

- Soils near the Central Maintenance Building
- MotoX Park
- A proposed demolition derby track
- Former Tree Nursery area.

At least 11 additional sampling events occurred after the initial 2002 event in order to gain a more complete understanding of the occurrence of LA and/or vermiculite in soil (Table 3-1). Reasons for additional sampling included areas not originally sampled, areas known to have vermiculite containing materials and areas of high use. A discussion of soil sample strategies is provided in:

- Data Summary Report, Operable Unit 5 – Former Stimson Lumber Company, Libby Asbestos Site, Libby, MT (CDM. 2007a).

- Sampling Summary Report, 2007 Investigations, Operable Unit 5 – Former Stimson Lumber Company, Libby Asbestos Site, Libby, MT (CDM. 2008).

Soil samples included grab and composite samples. Grab samples were collected as a shallow core approximately 2 inches in diameter and no more than 6 inches bgs. Composites were comprised of between two and thirty grab samples. In some cases, the individual grab samples were analyzed along with the composite.

Figure 3-1 shows locations of all surface soil samples (grab or composite) that were collected and analyzed (or otherwise examined). The variability in sample density apparent on this figure relates to the various strategies employed to characterize surface soils at OU5 during period of field investigations (2002-2009).

An initial, roughly systematic sampling event was intended to provide general coverage of OU5. Sample spacing of this initial event is apparent in the west-central portion of OU5 (Figure 3-1). This initial investigation omitted the LG Site, which was later subject to additional, relatively dense systematic sampling as shown on the figure.

Subsequent localized investigations of surface soil focused on specific areas where vermiculite (and therefore, associated LA) was either observed or otherwise suspected to be present based on historical land use (e.g., former vermiculite popping plant).

In addition, locations with current or proposed high-use recreational lands were also the target of stand-alone investigations. These included the MotoX Park (Figure 3-1) and a proposed demolition derby (proximal to the MotoX Park).

Prior to selecting the locations for Outdoor Worker ABS events, all existing OU5 surface soil data were examined to discern trends in spatial variability of LA or vermiculite occurrence. The purpose of this exercise was to allow selection of Outdoor Worker ABS locations that represented a range of surface soil contamination.

Ultimately, outdoor worker ABS areas were selected based on visual vermiculite inspection results. Previous sampling activities characterized vermiculite levels throughout most of OU5 based on visual inspection, and this information was used to categorize the level of vermiculite in the soil as None, Low, Moderate or High based on relative scoring (See Section 3.2.2). Outdoor Worker ABS areas were selected to include two areas from each category. Table 3-2 shows the visible inspection scores at the selected locations for the Outdoor Worker Exposure ABS. Outdoor Worker ABS locations are shown on Figure 3-1.

Once outdoor ABS locations were selected (for worker and recreational land uses), those areas were subject to additional surface soil sampling (as shown on Figure 3-1). All ABS areas were characterized by collecting and analyzing at least 30 individual grab samples and then also analyzing a 30-point composite sample comprised of the grabs. Most samples were analyzed to determine presence of LA. Analytical methods are discussed in Section 3.2.2.

The purpose of this additional sampling was three-fold:

- Verify that outdoor worker ABS areas did represent a range of LA levels and visible vermiculite conditions.
- Produce data that could be used to develop a mathematical relationship between LA occurrence in soil and in air.
- Evaluate whether composite sampling of OU5 soils is masking variability of LA occurrence in grab samples.

Subsurface Soil

Subsurface samples were collected in limited areas. Generally, these areas were selected based on the location of suspected buried LA containing materials including the former Popping Plant and a buried railroad spur (Figure 1-3). Sampling at these locations as well as a few scattered locations across OU5 included composites consisting of five grab samples collected from depths of 40 to 60 inches bgs. Additional subsurface grab samples were collected as part of the LG Site investigation in 2007. These samples were collected from depths of 12-15 inches bgs.

3.1.4 Waste Bark

Waste bark is stored on OU5 in stockpiles (see Figure 1-3). On October 15, 2007, bulk waste bark debris samples were collected to test for a presence of LA and to evaluate removal options and potential future uses.

Waste bark piles were split into 100 feet by 100 feet grids. Sampling was conducted using a test pit method in each grid. A total of 27 bulk material samples and one field duplicate were collected from the top, middle and bottom section of each waste bark test pit. Of these 27 samples, 19 field samples and one field duplicate were analyzed. The remaining samples may be analyzed at a later date, as directed by the EPA (CDM, 2008).

3.2 SAMPLE PREPARATION AND ANALYSIS

A detailed description of the number of samples analyzed from each sampling event, sampling and analytical methods used and detection results is provided in Appendix B. A thorough description of sample preparation and analytical methodology is also provided in Appendix C and summarized below.

3.2.1 Air and Dust

In the past, the most common technique for measuring asbestos in air was phase contrast microscopy (PCM). In this technique, air is drawn through a filter and airborne particles become deposited on the face of the filter. All structures that have a length greater than 5 micrometers (um) and have an aspect ratio (the ratio of length to width) of 3:1 or more are counted as PCM fibers. The limit of resolution of PCM is about 0.25 um, so particles thinner than this are generally not observable.

A key limitation of PCM is that particle discrimination is based only on size and shape. Because of this, it is not possible to classify asbestos particles by mineral type, or even to distinguish between asbestos and non-asbestos particles. For this reason, nearly all samples of air collected in Libby are analyzed by transmission electron microscopy (TEM).

This method operates at higher magnification (typically about 20,000x) and hence is able to detect structures much smaller than can been seen by PCM. In addition, TEM instruments are fitted with accessories that allow each particle to be classified according to mineral type.

If air samples were not deemed to be overloaded by particulates[1], filters are directly prepared for analysis by transmission electron microscopy (TEM) in accord with preparation methods provided in International Organization for Standardization (ISO) 10312 (ISO, 1995).

[1] Overloaded i s de fined a s >25% obs curation on the majority of t he grid ope nings (see Libby Laboratory Modification #LB-000016 and SOP EPA-LIBBY-08).

If air samples are deemed to be overloaded, samples are prepared indirectly in accord with procedures in SOP EPA-LIBBY-08. In brief, rinsate or ashed residue from the original filter is suspended in water and sonicated. An aliquot of this water is applied to a second filter which is then used to prepare a set of TEM grids. Reported air concentrations for indirectly prepared samples incorporate a dilution factor.

Air and dust samples collected as part of the OU5 sampling programs were analyzed by TEM in basic accord with counting and recording rules specified in ISO 10312, and project-specific counting rule modifications specified in the respective SAPs. These modifications included changing the recording rule to include structures with an aspect ratio ≥ 3:1.

For each countable structure particle identified, the analyst records structure-specific information (e.g., length, width, asbestos mineral type) which is then used to calculate air concentration in LA structures per cubic centimeter (s/cc) or dust loading in s/cm^2.

3.2.2 Soil and Bulk Material

Polarized Light Microscopy (PLM)

Soil samples collected as part of the OU5 sampling programs were prepared for analysis in accord with SOP ISSI-LIBBY-01 as specified in the CDM Close Support Facility (CSF) Soil Preparation Plan (CDM, 2004). In brief, each soil sample is dried and sieved through a ¼ inch screen. Particles retained on the screen (if any) are referred to as "coarse" fraction. Particles passing through the screen are referred to as fine fraction, and this fraction is ground by passing it through a plate grinder. Resulting material is referred to as "fine ground" fraction. The fine ground fraction is split into four equal aliquots; one aliquot is submitted for analysis and the remaining aliquots are archived at the CSF.

Soil samples are analyzed using PLM whereby the analyst estimates the amount of asbestos in the sample (expressed as percent by weight) based on visual estimation techniques and by comparison to reference materials.

The coarse fractions were examined using stereomicroscopy, and any particles of asbestos (confirmed by PLM) were removed and weighed in accord with SRC-LIBBY-01 (referred to as "PLM-Grav"). Fine ground aliquots were analyzed using a Libby-specific PLM method using visual area estimation, as detailed in SOP SRC-LIBBY-03. For convenience, this method is referred to as "PLM-VE."

PLM-VE is a semi-quantitative method that utilizes site-specific LA reference materials to allow assignment of fine ground samples into one of four "bins," as follows:

- *Bin A (ND):* non-detect
- *Bin B1 (Trace):* detected at levels lower than the 0.2% LA reference material

- *Bin B2 (<1%):* detected at levels lower than the 1% LA reference material but higher than the 0.2% LA reference material
- *Bin C:* LA detected at levels greater than or equal to the 1% LA reference material

<u>Visual Inspection</u>

For soil samples, field teams also provide a semi-quantitative estimate of visible vermiculite present at soil sampling point(s). Visual inspection data can be used to characterize the level of vermiculite (and presumptive LA contamination) in an area and considers both frequency and level of vermiculite. This is achieved by assigning a weighting factor to each level, where weighting factors are intended to represent relative levels of vermiculite in each category. As presented in SOP CDM-LIBBY-06, guidelines for assigning levels are as follows:

- None – No flakes of vermiculite observed within the soil sample.
- Low – A maximum of a few flakes of vermiculite observed within the soil sample.
- Moderate – Vermiculite easily observed throughout the soil sample, including the surface and contains <50% vermiculite.
- High – Vermiculite easily observed throughout the soil sample, including the surface and contains 50% or more vermiculite.

Based on these descriptions, weighting factors used to characterize magnitude of LA occurrence in soil are as follows:

Visible Vermiculite Level (L_i)	Weighting factor (W_i)
None	0
Low	1
Moderate	3
High	10

The composite score is then the weighted sum of the observations for the area:

$$Score = \frac{\sum_{i=1}^{30} L_i * W_i}{30}$$

This value can range from zero (all 30 points are "none") to a maximum of 10 (all 30 points are "high"). For example, an ABS area with 1 "low" point and 29 "none" points would receive a value of 1/30 = 0.033, while an ABS area with 24 "intermediate" points and 5 "high" would receive a score of (24·3 + 5·10) / 30 = 4.13.

In addition to the visual estimation method described above, field crews used a less sophisticated technique prior to implementation of SOP CDM-LIBBY-06 in 2006. This involved noting in the field the simple presence or absence of visible vermiculite in soil samples.

3.2.3 Waste Bark

Waste bark samples were analyzed by adding a sample of test material to water, shaking, and allowing the sample to separate into "sinks" (mineral particles that settle to the bottom), "floats" (particles of wood that rise to the top), or "suspended" (particles that remain in the water). The "sinks" are collected, dried, and analyzed using EPA-Libby-10, Analysis of Waste Bark and Wood Chip Samples for Fibrous Amphibole, a qualitative analysis method utilizing PLM and TEM. If no fibrous amphibole is detected in the "sinks", then a sample of the water is analyzed by TEM for suspended amphibole. If fibrous amphibole is detected in either fraction, the sample is reported as "detect". If fibrous amphibole is detected in neither fraction, the sample is reported as "non-detect".

4.0 DATA RECORDING, DATA QUALITY ASSESSMENT, AND DATA SELECTION

4.1 DATA RECORDING

All analytical results are stored and maintained in the Libby 2 Database (Libby2DB) and more recently the Libby Data Warehouse. Appendix D1 provides an electronic copy of the database.

Detailed summaries of sample results for environmental media collected in OU5 through 2007 are provided in CDM (2007a) and CDM (2008). Standardized data entry spreadsheets (electronic data deliverables or EDDs) have been developed specifically for the Libby project to ensure consistency between laboratories in the presentation and submittal of analytical data. In general, a unique EDD has been developed for each type of analytical method. Each EDD provides the analyst with a standardized laboratory bench sheet and accompanying data entry form for recording analytical data. Data entry forms contain a variety of built-in quality control functions that improve accuracy of data entry and help maintain data integrity. These spreadsheets also perform automatic computations of analytical input parameters (e.g., sensitivity, dilution factors, and concentration), thus reducing the likelihood of analyst calculation errors. The EDDs generated by the laboratories are uploaded directly into the Libby site database.

Hard copies of all FSDSs, field log books, and chain of custody forms generated during the various OU5 sampling program are stored in the CDM field office in Libby, Montana.

Hard copies of all analytical bench sheets are included in analytical laboratory reports. These analytical reports are submitted to the Libby Laboratory Coordinator and stored at CDM offices in Denver, CO.

Historically, sample and analytical electronic data were stored and maintained in the Libby2DB which was housed on a structured query language (SQL) server at EPA Region 8 in Denver, Colorado. At the time of this report, EPA was in the process of transitioning to a new data management system, referred to as Scribe.net. In the future, sample and analytical electronic data will be stored and maintained in the Libby Data Warehouse which is populated by Scribe.net and housed on the EPA network.

4.2 DATA QUALITY ASSESSMENT

Data quality assessment (DQA) is the process of reviewing existing data to establish the quality of the data and to determine how any data quality limitations may influence data interpretation (EPA, 2006). The full DQA is provided as Appendix E.

For the purposes of the risk assessment (Section 7), the principle datasets utilized to quantify potential exposures are the air samples collected during the various ABS programs at OU5.

In addition, soil data (both visible vermiculite inspection results and PLM-VE results) are utilized in the interpretation of Outdoor Worker ABS results. Therefore, the DQA focuses on ABS air samples and Site-wide soil samples used to support the OU5 risk assessment.

The DQA process considered the following:

- Field and laboratory audit results.
- Field and laboratory quality control sample results.
- Data entry verification.
- Comparison of data collected with specified data quality objectives (DQOs) stated in the respective ABS SAPs.

Results of the DQA indicate that air and soil data collected at OU5 and utilized in the risk assessment generally are of acceptable quality, adequate and representative, and considered to be reliable and appropriate for use in the RI including the risk assessment.

4.3 DATA SELECTION

Raw data for samples utilized in describing the occurrence of LA in OU5 soils and air (Section 5) as well as for use in the risk assessment (Section 7) were obtained via a subscription to the Libby OU5 project database through Scribe.net. A copy of this database was obtained by SRC, Inc. on March 12, 2010, and is provided electronically in Appendix D1 of this report.

Because all data had not yet been migrated from Libby2DB to Scribe.net at the time of this report (e.g., quality control samples and analyses, air pump information, etc.), data were supplemented by results from the Libby2DB. The Libby2DB was downloaded into a Microsoft Access® database by SRC, Inc. on December 8, 2009. Note that any changes made to these databases since they were obtained/download will not be reflected in Appendix D1.

In addition, supplemental GPS coordinate data for historical soil samples were provided by CDM on March 25, 2010. An Microsoft Excel® spreadsheet summarizing these coordinate data is provided in Appendix D1.

Scribe queries were written to sort data by media, analytical method and to exclude quality control samples. The Scribe queries for soil and air samples are provided in Appendix D2. The data set resulting from execution of the queries was used to describe the nature and extent of LA occurrence and for calculation of human health risk estimates.

5.0 NATURE AND EXTENT OF LA

5.1 CONTAMINANTS OF CONCERN

The contaminant of concern at the Libby Site is asbestos. Asbestos is the generic name for the fibrous form of a broad family of naturally occurring poly-silicate minerals. Based on crystal structure, asbestos minerals are usually divided into two groups - serpentine and amphibole.

- Serpentine - The only asbestos mineral in the serpentine group is chrysotile. Chrysotile is the most widely used form of asbestos, accounting for about 90% of the asbestos used in commercial products (IARC, 1977). There is no evidence that chrysotile occurs in the Libby vermiculite deposit, although it may be present in some types of building materials in Libby.
- Amphibole – Five minerals in the amphibole group that occur in the asbestiform habit have found limited use in commercial products (IARC, 1977), including actinolite, amosite, anthophyllite, crocidolite, and tremolite.

At the Libby Site, the form of asbestos that is present in the vermiculite deposit is amphibole asbestos that for many years was classified as tremolite/actinolite (e.g., McDonald et al., 1986a, Amandus and Wheeler, 1987). More recently, the U.S. Geological Service (USGS) performed electron probe micro-analysis and X-ray diffraction analysis of 30 samples obtained from asbestos veins at the mine (Meeker et al., 2003). Using mineralogical naming rules recommended by Leake et al. (1997), the results indicate that asbestos at Libby includes a number of related amphibole types. The most common forms are winchite and richterite, with lower levels of tremolite, magnesioriebeckite and possibly actinolite.

Because mineralogical name changes that have occurred over the years do not alter the asbestos material that is present in Libby, and because EPA does not find that there are toxicological data to distinguish differences in toxicity among these different forms, the EPA does not believe that it is important to attempt to distinguish among these various amphibole types. Therefore, EPA simply refers to the mixture as Libby amphibole (LA) asbestos.

5.2 LA IN AIR

As discussed in Section 7.2.3, the amount of LA fibers released to air will vary depending upon the level of LA in the source material (e.g., outdoor soil, indoor dust) and the intensity and duration of the disturbance activity. Because of this, predicting the LA levels in air associated with disturbance activities based only on measured LA levels in the source material is extremely difficult. Therefore, ABS is considered to be the most direct way to estimate potential exposures from inhalation of asbestos. ABS results for indoor and outdoor air are summarized on Figures 5-1 and 5-2, respectively.

Indoor Air

Figure 5-1 summarizes ABS results for existing buildings except those that have fewer than four walls or have a dirt floor. In addition, no ABS air data is available for the Finger Jointer Process Plant.

Samples from most vacant buildings contained no detectable LA. Samples from most occupied buildings contained detectable LA. For buildings where LA was detected, the mean concentration varied by a factor of 1,000. Human health risk estimates based on these measurements are provided in Section 7.

Outdoor Air

Figure 5-2 summarizes results for the eight Outdoor Worker ABS locations and ABS conducted along the bicycle path and at the MotoX Park. LA was detected in seven of the eight Outdoor Worker ABS areas. The mean LA concentration varied by a factor of 10 across the seven areas where LA was detected.

Sampling at the MotoX Park included stationary samplers proximal to the location of spectators as well as samplers fixed to handlebars of dirtbikes. No LA fibers were detected in any sample.

Sampling was conducted separately for paved and unpaved portions of the bike path. On the paved path, a stationary air monitor was also mounted in a trailer attachment to one of the bicycles to characterize potential exposures to a young child being pulled by a parent. Samples from the trailer were not collected from the unpaved portion of the path because the unpaved portion of the path is steep and narrow in sections, and is not safe for pulling a trailer. The mean LA concentrations for the adult and child were similar. Human health risk estimates based on these measurements are provided in Section 7.

5.3 LA IN DUST

Figure 5-3 illustrates buildings that have been sampled for indoor dust and presents the total LA dust loading results relative to the current EPA removal action level for indoor dust (> 5,000 total LA s/cm^2; EPA, 2003a).

Of the 87 indoor dust field samples collected, 28 samples had detectable levels of LA, with detectable levels ranging from 35 to 44,116 total LA s/cm^2. Only four samples had detectable levels of LA above the current EPA removal action level:

- Former Tree Nursery area shed – Total LA dust loading was 7,026 s/cm^2 for one composite sample collected in May 2002 from sampling locations atop wood piles and from a ground level beam in this shed. This building was no longer present during the 2007 site visit (CDM, 2007a).

- Central Maintenance Building – Total LA dust loading was 8,823 s/cm^2 for one of 29 composite samples collected from this building in September 2002. This sample was collected from two engine rooms and the main work area. The source of dust contamination in this building was likely vermiculite insulation and vermiculite-containing building materials which were subsequently removed in 2005 (CDM, 2007a).

- Diesel Fire Pump House – Total LA dust loading was 8,823 s/cm^2 for one composite sample collected from three areas within this building in September 2002.

- Guard Station at Libby Creek Bridge – Total LA dust loading was 44,116 s/cm^2 for one composite sample collected from this building in September 2002. The guard station did not contain vermiculite insulation at the time of sampling (CDM, 2007a). This building was no longer present during the 2007 site visit (CDM, 2007a).

The Central Maintenance Building has been cleaned several times to remove LA impacted building material and to decontaminate interior surfaces. Subsequent ABS air sampling of the buildings that remain as of June 2010 (Central Maintenance Building and Diesel Fire Pump House) indicated that risks to human health are below a level of concern (See Section 7).

5.4 LA IN SOIL

Surface Soil

Figure 5-4 illustrates LA occurrence in OU5 surface soils based on PLM results. A 4-color scheme is used to indicate the amount of LA present in a sample (additional detail on analytical reporting is provided in Appendix C):

- green = Bin A (non-detect)
- yellow = Bin B1 (trace)
- orange = Bin B2 (< 1%)
- red = Bin C (≥ 1%)

In this figure, individual grab samples (primarily collected within the Outdoor Worker ABS areas) are shown as triangles, and composite samples are shown as circles plotted at the mid-point of the area. Composite samples are representative of a larger area than the plotting point presented in this figure.

Figure 5-5 illustrates vermiculite occurrence in OU5 soils based on visual vermiculite inspection results. In this figure, historical observations of visible vermiculite which utilized a qualitative present/absent approach are shown as triangles.

More recent visible vermiculite observations which utilized a semi-quantitative approach are shown as squares and are color-coded based on the visible score (see Section 3.2.2). A 4-color scheme is used to indicate visible score data:

- green = score of 0 (no visible detected)
- yellow = score < 0.1
- orange = score 0.1 to < 0.3
- red = score > 0.3

One potential limitation to the approach for presenting visible score data is that the choice of cut-offs for use in color-coding is arbitrary. If other cut-offs were chosen, the appearance of the figures would be different. For example, the cutoff for red is 0.3 out of a possible score of 10. Nevertheless, the figures do provide a useful indication of the degree to which there is variation across OU5 and locations where higher than average levels have been observed.

As shown in Figure 5-4, PLM results are generally non-detect or trace across OU5. The one location where PLM results have consistently been higher (with observed LA levels up to 1%) is the north-central portion of the former Tree Nursery area. This location also has elevated visible scores (see Figure 5-5).

Differences in the more recent visual vermiculite results compared to the original results likely arises from the inherently subjective nature of the category assignments, as well as variations in site conditions between rounds (e.g., cloud cover vs. sunshine, amount of ground cover, soil moisture, etc.).

<u>Subsurface Soil</u>

PLM and visual inspection results for subsurface soils are presented on Figure 5-6. LA was not detected in any composite sample collected near the former Popping Plant or in other samples scattered across the remainder of OU5. LA was reported as <1% in a single composite sample collected along the railroad spur.

LA was not detected in any of the grab samples collected in the LG Site. Visible vermiculite was noted as "moderate" in a single sample. Unlike the visible vermiculite score used to describe the relative level of vermiculite in composite samples, the result for individual grab samples is expressed as none, low, moderate or high, as discussed Section 3.2.2.

These results suggest that, in the areas examined, the occurrence of LA or vermiculite does not increase with depth.

5.5 LA IN WASTE BARK

Of the 19 waste bark samples analyzed, LA was detected in 1 sample analyzed by PLM, and LA was detected in 13 samples by TEM. These results show that LA is present in these piles, but it is not possible to quantify how much LA may be present based on the qualitative method used for waste bark (See Section 3.2.3).

6.0 CONTAMINANT FATE AND TRANSPORT

As discussed in Section 1.4, asbestos containing material was potentially transported to OU5 via the following activities:

- The former Popping Plant was once used as an aboveground storage area for uncontained vermiculite ore. Ore was stockpiled directly on the native soil surface in this area.
- The Railroad Spur was used for shipping raw and unprocessed vermiculite material to and from the site.
- The former Tree Nursery may have introduced raw vermiculite product into this area as a growth medium and fill material.

The fate and transport of asbestos containing fibers is dependent on the type of host media (soil, water, air, etc.), land use, and site characteristics. Asbestos fibers (both serpentine and amphibole) are indefinitely persistent in the environment. According to the Agency for Toxic Substances and Disease Registry (ATSDR):

> *"Asbestos fibers are nonvolatile and insoluble, so their natural tendency is to settle out of air and water, and deposit in soil or sediment (EPA 1977, 1979c). However, some fibers are sufficiently small that they can remain in suspension in both air and water and be transported long distances. For example, fibers with aerodynamic diameters of 0.1–1 μm can be carried thousands of kilometers in air (Jaenicke 1980), and transport of fibers over 75 miles has been reported in the water of Lake Superior (EPA 1979c)."* In addition*, "they are resistant to heat, fire, and chemical and biological degradation"* (ATSDR, 2001).

The primary transport mechanisms for asbestos and asbestos containing material include:

- Suspension in air and transport via dispersion
- Suspension in water and transport downstream

Asbestos can become suspended in air when asbestos or asbestos containing material is disturbed. Wind, recreational activities, construction, and site work can disturb material outdoors. Indoors, asbestos can be suspended when contaminated material (usually insulation) is disturbed by cleaning, renovation or other general disruption.

Asbestos residence time in the air is determined primarily by particulate thickness; however it is influenced by other factors such as length and static charge. The average thickness of LA particles is 0.4 μm and ranges from approximately 0.1 to 1.0 μm. The suspension of LA in air is measured in "half times" which is the amount of time it will take 50% of LA particles to settle out of the air column. A particle with a thickness of 0.5 μm has a half time of approximately two hours, assuming the source of disturbance has been removed.

Larger particles will settle faster; a particle of 1 µm has a half time of about 30 minutes. Smaller LA particles may stay suspended for significantly longer. The typical half time for a 0.15 particle is close to 40 hours (CDM, 2007a)

Activity-specific testing found that the half-time of LA suspended by dropping vermiculite on the ground was about 30 minutes. LA suspended from disturbing vermiculite insulation settled within approximately 24 hours.

Once suspended, LA moves by dispersion through air. LA concentration will be highest near the source and will decrease with increasing distance. In outdoor air, wind speed will determine direction and velocity of LA particle transport. Wind can cause the rapid dispersal of LA from the source of release. In indoor air, mixing usually takes from 5 to 30 minutes, but is dependent on airflow within the building.

In water, LA particles can be transported downstream with the current. As in air, larger particles tend to settle to the bottom more rapidly than smaller particles. Settled particles may be transported downstream with sediment (CDM, 2009).

LA is insoluble and therefore transport in solution will not occur in surface water, groundwater or from soils to water. Further, as a particle, LA is not expected to be mobilized from surface or near surface soils vertically through the soil column to the water table.

7.0 HUMAN HEALTH RISK ASSESSMENT

7.1 OVERVIEW

This section presents the human health risk assessment for OU5 of the Site.

As discussed previously, vermiculite from the Libby mine contains varying concentrations of a form of asbestos referred to as Libby amphibole (LA)asbestos. Releases of LA (in association with vermiculite) to the environment have caused a range of adverse health effects in exposed people, including not only workers at the mine and processing facilities (Amandus and Wheeler, 1987; McDonald et al., 1986a, 1986b, 2004; Whitehouse 2004; Sullivan 2007), but also in residents of Libby (Peipins et al. 2003; Noonan et al., 2006; Whitehouse et al., 2008). Adverse health effects are not associated with the vermiculite mineral itself.

This risk assessment uses available data to estimate the health risks to people who may breathe asbestos in air while working in or visiting OU5, either now or in the future, based on the conditions that currently exist within OU5. The methods used to evaluate human health risks from asbestos are in basic accord with EPA guidelines for evaluating risks at NPL sites (EPA 1989), including recent guidance (EPA, 2008a) that has been specifically developed to support evaluations of exposure and risk from asbestos.

It is important to recognize that many people exposed to asbestos at OU5 may also be exposed to asbestos at other locations in and around Libby. While this risk assessment focuses exclusively on risks at OU5, the cumulative risks from exposure pathways that may occur throughout the Site will be addressed in the future.

An ecological risk assessment is being developed for the mine site (OU3). EPA will build upon the information gathered during that ecological risk assessment to identify potential pathways and receptors to evaluate ecological risk at OU5. If ecological exposure pathways are identified at OU5, an ecological risk assessment will be performed.

7.2 EXPOSURE ASSESSMENT

7.2.1 Initial Conceptual Site Model

Figure 7-1 presents the initial Conceptual Site Model (CSM) that was developed in 2007 (EPA, 2007a) to summarize how humans might be exposed to LA at OU5. As seen, this includes four categories of receptors, each of whom may be exposed to LA in air by several alternative exposure pathways. Key elements of the CSM are described below.

7.2.1.1 Exposed Populations

Based on the current and potential future land use at OU5, people who are most likely to be exposed on a regular basis include:

- Commercial/industrial workers at OU5, either now or in the future.
- Local tradespersons performing indoor or outdoor maintenance activities, either now or in the future.
- Recreational visitors to parts of OU5, now or in the future.
- Hypothetical future residents in OU5, if the area were ever redeveloped for residential land use.

7.2.1.2 Exposure Routes and Pathways

People who visit or work at OU5 may be exposed to LA by incidental ingestion of contaminated media (e.g., soil, dust, water) and by inhalation of air that contains LA fibers. Of these two pathways, inhalation exposure is considered to be of greatest concern. To the extent that incidental ingestion exposure of LA may occur, the added risk from this pathway is expected to be small compared to the risk from the inhalation pathway.

LA fibers may become airborne in a number of ways. This may include natural forces such as wind blowing over contaminated soil, or human activities that disturb contaminated sources such as indoor dust or outdoor soil. The amount of LA in air, and hence the amount inhaled, will vary depending on the level of LA in the source, and also on the intensity and duration of the disturbing force. Because of this, it is convenient to stratify inhalation exposures according to source material and according to disturbance activity. Based on this approach, the exposures of chief concern for each of the exposed populations are as follows:

- Current or future workers at OU5 may either work indoors or outdoors. Indoor workers may be exposed to LA in indoor air due to disturbance of contaminated indoor dust. Outdoor workers may be exposed to LA in air during activities that disturb contaminated soil and/or contaminated waste bark.

- Current or future tradespersons at OU5 may engage in both indoor and outdoor maintenance activities, such as interior remodeling and construction, landscape maintenance, and building repair and maintenance. These activities may result in disturbances of various source media, including indoor vermiculite insulation and outdoor soils.

- Current or future recreational visitors to OU5 are assumed to be exposed only outdoors. It is assumed that visitors might engage in a wide variety of different types of behaviors that may disturb soils, including hiking, bicycle riding, and bird watching. Some visitors may also engage in activities at the MotoX Park (either as participants or spectators).

- Hypothetical future residents could be exposed to LA in both indoor air of the home and in outdoor air during activities such as mowing, raking or digging in the yard.

In addition, all individuals who work at or visit the OU5 Site may be exposed to ambient outdoor air. Those individuals who travel in OU5 by car might be exposed by transfer of contaminated soil into the car, followed by subsequent inhalation exposure while driving.

Exposures of other people who visit OU5 on a less frequent basis (e.g., out of town visitors) would be lower than the exposures for the populations described above.

7.2.2 Simplified Conceptual Site Model

At present, EPA has collected sufficient data to allow evaluation of exposure pathways that are thought to be most likely of potential concern in OU5. These pathways are shown by black dots in Figure 7-2, and include the following:

- Exposure of indoor workers to residual LA in indoor air of existing buildings at OU5
- Exposure of outdoor workers to residual contamination in outdoor soil at OU5
- Exposure of motorcycle riders and spectators at the MotoX Park in OU5
- Exposure of bicycle riders along the recreational trail in OU5

These exposure pathways are the main focus of this risk assessment. EPA will consider the potential need to collect additional data that would be required to evaluate other potential exposure scenarios (e.g., exposure of tradespersons, exposures inside vehicles) after assessment of the primary pathways shown in Figure 7-2.

Note that hypothetical future residential exposure pathways are not included in Figure 7-2. This is because the current land use in OU5 is commercial/industrial, and it is not expected that the land will be developed for residential land use. If this land use designation were to change in the future, potential exposures for this receptor population would need to be investigated.

7.2.3 Approach for Characterizing Exposure

The amount of LA fibers released to air will vary depending upon the level of LA in the source material (e.g., outdoor soil, indoor dust) and the intensity and duration of the disturbance activity. For outdoor exposures, a variety of meteorological (e.g., relative humidity, wind direction and speed) and source material conditions (e.g., soil moisture, vegetative cover) will also influence releases to air. Because of this, predicting the LA levels in air associated with disturbance activities based only on measured LA levels in the source material is extremely difficult. Therefore, the most direct way to determine potential exposures from inhalation is to measure the concentration of asbestos in air in association with a specific activity that disturbs a source material. For convenience, this is referred to as activity-based sampling (ABS) (EPA 2008a).

EPA performed several ABS studies at the OU5 site in 2007 and 2008 to investigate the levels of LA in air associated with a variety of activities under current conditions, including:

- Visitors participating in and viewing MotoX activities at the MotoX Park (EPA, 2008b).
- Visitors riding a bicycle on the bike path along Libby Creek (EPA, 2008c).
- Workers engaging in outdoor activities at various locations on the OU5 site (EPA, 2008d, CDM, 2007).
- Workers engaging in indoor activities in various buildings on the OU5 site (EPA, 2007a).

A detailed description of the study design and data quality objectives (DQOs) for each ABS study is provided in the respective sampling and analysis plans (SAPs) cited above. ABS air samples collected as part of these studies provide the basis for the quantitative evaluation of the exposure pathways illustrated in Figure 7-2.

7.3 TOXICITY ASSESSMENT

The adverse effects of asbestos exposure in humans have been the subject of a large number of studies and publications. The following section provides a brief overview of the primary types of adverse health effects that have been observed in humans. More detailed reviews of the literature are provided in IARC (1977), WHO (2000), and ATSDR (2001, 2004).

7.3.1 Non-Cancer Effects

7.3.1.1 Asbestosis

Asbestosis is a chronic pneumoconiosis associated with inhalation exposure to asbestos. It is characterized by the gradual formation of scar tissue in the lung parenchyma. Initially the scarring may be minor and localized within the basal areas, but as the disease develops, the lungs may develop extensive diffuse alveolar and interstitial fibrosis (American Thoracic Society, 1986).

Build-up of scar tissue in the lung parenchyma results in a loss of normal elasticity in the lung which can lead to the progressive loss of lung function. The initial symptoms of asbestosis are shortness of breath, particularly during exertion. People with fully developed asbestosis tend to have increased difficulty breathing that is often accompanied by coughing or rales. In severe cases, impaired respiratory function can lead to death.

Asbestosis generally takes a long time to develop, with a latency period from 10 to 20 years. Mossman and Churg (1998) suggest that latency is inversely proportional to exposure level. The disease may continue to progress long after exposure has ceased (ATSDR, 2001). The progression of the disease after cessation of exposure also appears to be related to the level and duration of exposure (American Thoracic Society, 2004).

7.3.1.2 Pleural Abnormalities

Exposure to asbestos may induce several types of abnormality in the pleura (the membrane surrounding the lungs).

- *Pleural effusions* are areas where excess fluid accumulates in the pleural space. Most pleural effusions last several months, although they may be recurrent.
- *Pleural plaques* are acellular collagenous deposits, often with calcification. Pleural plaques are the most common manifestations of asbestos exposure (ATSDR, 2001; American Thoracic Society, 2004).
- *Diffuse pleural thickening* is a non-circumscribed fibrous thickening of the visceral pleura with areas of adherence to the parietal pleura. Diffuse thickening may be extensive and cover a whole lobe or even an entire lung. Infolding of thickened visceral pleura may result in collapse of the intervening lung parenchyma (rounded atelectasis). Gevenois et al. (1998) and Schwartz et al. (1991) report that diffuse pleural thickening may occur as a result of pleural effusions.

Pleural effusions and plaques are generally asymptomatic, although rarely they may be associated with decreased ventilatory capacity, fever, and pain (e.g., Bourbeau et al., 1990). Diffuse pleural thickening can cause decreased ventilatory capacity (Baker et al., 1985; Churg 1986; Jarvholm and Larsson, 1988). Severe effects are rare, although Miller et al. (1983) reported on severe cases of pleural thickening that lead to death.

The latency period for pleural abnormalities is usually about 10 to 40 years (American Thoracic Society, 2004), although pleural effusions may occasionally develop as early as one year after first exposure (Epler and Gaensler, 1982).

7.3.1.3 Other Non-Cancer Effects

Some epidemiological studies provide evidence that chronic exposure to asbestos can increase the risk of several other types of non-cancer effects including cor pulmonale (right-sided heart failure), retroperitoneal fibrosis (a fibrous mass in the back of the abdomen that blocks the flow of urine from the kidneys to the bladder), depressed cell-mediated immunity (ATSDR, 2001), and autoimmune disease (Pfau et al., 2005; Noonan et al., 2006).

7.3.1.4 Observations of Non-Cancer Effects in People Exposed to LA

A number of studies have been performed to characterize the types of non-cancer effects that occur in people who have been exposed to LA. These studies are summarized below.

Amandus and Wheeler (1987), McDonald et al. (1986a, 1986b, 2004), and Sullivan (2007) studied the cause of death in workers exposed to LA while working at the vermiculite mine and mill at Libby.

Each of these researchers reported that Libby workers were more likely to die of non-malignant respiratory disease (NMRD) (i.e., asbestosis, chronic obstructive pulmonary disease, pneumonia, tuberculosis and emphysema) compared to white males in the general U.S. population, supporting the conclusion that exposure to LA increases risk of non-malignant lung disease.

Armstrong et al. (1988), McDonald et al. (1986b) and Amandus et al. (1987) evaluated the prevalence of chest radiographic changes in workers exposed to LA while working at the vermiculite mine and mill at Libby. These researchers observed increased prevalence in pleural changes, including pleural calcification, pleural thickening and profusion of small opacities among exposed workers.

Rohs et al. (2007) studied the prevalence of pleural changes in the lungs of workers exposed to LA while working at a facility in Marysville, Ohio expanding Libby vermiculite for use as an inert carrier for lawn care products. Rohs et al. (2007) observed an increased incidence of pleural plaques, diffuse pleural thickening and interstitial changes (irregular opacities) in exposed workers. In addition, studies by Peipins et al. (2003), Muravov et al. (2005), and Whitehouse (2004) also observed increased incidence in pleural abnormalities of not only workers, but also household contacts of former employees of the Libby mine and residents of Libby, MT environmentally exposed to LA. These findings support the conclusion that exposure to LA can induce pleural abnormalities.

7.3.2 Cancer Effects

Many epidemiological studies have reported increased mortality from cancer in asbestos workers, especially from lung cancer and mesothelioma. Based on these findings, and supported by extensive carcinogenicity data from animal studies, EPA has classified asbestos as a known human carcinogen (EPA, 1993).

7.3.2.1 Lung Cancer

Exposure to asbestos is associated with increased risk of developing all major histological types of lung carcinoma (adenocarcinoma, squamous cell carcinoma, and oat-cell carcinoma) (ATSDR, 2001). The latency period for lung cancer generally ranges from about 10 to 40 years (ATSDR, 2001). Early stages are generally asymptomatic, but as the disease develops, patients may experience coughing, shortness of breath, fatigue, and chest pain. Most lung cancer cases result in death. The risk of developing lung cancer from asbestos exposure is substantially higher in smokers than in non-smokers (Selikoff et al., 1968; Doll and Peto, 1985; ATSDR, 2001; NTP, 2005).

7.3.2.2 Mesothelioma

Mesothelioma is a tumor of the thin membrane that covers and protects the internal organs of the body including the lungs and chest cavity (pleura), and the abdominal cavity (peritoneum).

Exposure to asbestos is associated with increased risk of developing mesothelioma (ATSDR, 2001).

The latency period for mesothelioma is typically around 20-40 years (Lanphear and Buncher, 1992; ATSDR, 2001; Mossman et al., 1996; Weill et al., 2004). By the time symptoms appear, the disease is most often rapidly fatal (British Thoracic Society, 2001).

7.3.2.3 Other Cancers

A number of studies suggest asbestos exposure may increase risk of cancer at various gastrointestinal sites (EPA, 1986). National Academy of Sciences (NAS, 2006) reviewed evidence regarding the role of asbestos in gastrointestinal cancers primarily following occupational exposures (these are assumed to be primarily by the inhalation route). NAS concluded that data are "suggestive but insufficient" to establish that asbestos exposure causes stomach or colorectal cancer. Data on esophageal cancer are mixed and were regarded as "inadequate to infer the presence or absence of a causal relationship to asbestos exposure".

Data on risks of gastrointestinal cancer following ingestion-only exposure are more limited. Some researchers (e.g., Conforti et al., 1981; Kjaerheim et al., 2005) have reported a significant correlation between oral exposure to asbestos in drinking water and the risk of gastrointestinal cancer. However, WHO (1996) concluded that data are not adequate to support the hypothesis that an increased cancer risk is associated with the ingestion of asbestos in drinking water.

NAS (2006) reviewed available data on the relationship between asbestos exposure and laryngeal cancer and concluded that the data were "sufficient to infer a causal relationship between asbestos and laryngeal cancer." NAS (2006) concluded that data are "suggestive but not sufficient to infer a causal relationship between asbestos exposure and pharyngeal cancer."

Excess deaths from kidney cancer among persons with known exposure to asbestos have been reported by a number of researchers (e.g., Selikoff et al., 1979; Enterline et al., 1987; Puntoni et al., 1979). A review by Smith et al. (1989) evaluated these studies and concluded that asbestos should be regarded as a probable cause of human kidney cancer.

7.3.2.4 Observations of Cancer in People Exposed to LA

Amandus and Wheeler (1987), Amandus et al. (1987), McDonald et al. (1986a, 1986b, 2004), and Sullivan (2007) studied the cause of death in workers exposed to LA while working at the vermiculite mine and mill at Libby. All of these groups of researchers reported an increased incidence of lung cancer and mesothelioma in exposed workers, strongly supporting the conclusion that LA can cause increased risk of respiratory cancer when inhaled.

7.3.3 Role of Fiber Type and Size in Adverse Health Effects

While all types of asbestos have been shown to induce asbestos-related disease in humans and in animals, a number of researchers have proposed that not all forms of asbestos are equally toxic. Current research has focused on two key variables: mineral type (chrysotile vs. various types of amphibole asbestos), and fiber size (length and width).

Several researchers have used available human epidemiological data to investigate the relative potency of asbestos as a function of mineral type. There is on-going debate regarding whether there is a difference in the relative cancer potencies of the various mineral types and sizes.

In particular, the carcinogenic potential of chrysotile asbestos relative to amphibole asbestos is a controversial issue. Based on lung burden studies, mechanistic studies, and some epidemiological data, some researchers (e.g., Hodgson and Darnton, 2000; Mossman et al., 1990; McDonald and McDonald, 1997) propose that amphibole fibers are more potent inducers of mesothelioma and potentially of lung cancer than chrysotile.

Studies on the importance of fiber size on toxicity come mainly from investigations in animals, especially experiments conducted by Davis et al. (1978, 1980, 1985, 1986a, 1986b) and Davis and Jones (1988). These studies all utilized a common protocol in which groups of about 40 rats were exposed by inhalation for seven hours per day, five days per week for 224 days over one year and then observed for at least another year. A range of different test materials were evaluated, including crocidolite, Korean tremolite, four types of chrysotile, and three types of amosite. Each type of asbestos was tested at an airborne concentration of 10 mg/m^3; several other concentrations were tested for some of the asbestos types. The original characterization of exposure materials in the studies by Davis et al. (1978, 1980, 1985, 1986a, 1986b) did not include comprehensive characterization of the distribution of the length and width of the suspended structures and did not include a count of structures thinner than 0.2 um. Because of these limitations, archived samples of the original stock samples were used to regenerate asbestos dust clouds (using the same equipment, procedures, and personnel as in the original studies) from which samples were taken and characterized more fully using transmission electron microscopy (TEM) techniques (Berman et al. 1995).

Using these detailed particle size and type data, Berman et al. (1995) conducted statistical analyses of the rat lung tumor incidence data to identify which size categories were best correlated with increased incidence of disease. No mathematical model with a single explanatory variable provided an adequate description of the lung tumor incidence. In contrast, multivariate models which included concentrations of particles in different size categories did provide an adequate description of the lung tumor incidence data. Fitting began with a model with five length categories (<5, 5-10, 10-20, 20-40, > 40 um) and five thickness categories (<0.15, 0.15-0.3, 0.3-1.0, 1.0-5.0, and > 5 um).

By eliminating bins that had potency factors that were not statistically different from zero and combining bins that were not statistically different from each other, Berman et al. (1995) developed a final model with three length categories (<5, 5-40, and >40 um) and two width categories (<0.3 and > 5 um).

The relative bin-specific potency factors for this model are summarized below:

Relative Potency Estimates Based on Rat Data

Width (um)	Length (um)		
	< 5	5-40	> 40
≤ 0.3	0	0.0017	0.853
≥ 5.0	0	0	0.145

Adapted from Berman et al. (1995)

As seen, fibers longer than 40 um accounted for 99.8% of the total potency, with most of that (85%) being contributed by fibers ≤ 0.3 um in diameter. Only a small contribution (<0.2%) was provided by fibers 5-40 um in length, and fibers less than 5 um did not contribute any observable potency. Further analysis of the available data in the context of the best-fitting model could not discern a difference in the lung-cancer-inducing potency of chrysotile and amphibole. Statistical analysis of the mesothelioma data indicated that amphibole potency was greater than chrysotile potency for equivalent size and shape particles (Berman et al., 1995).

Studies on the importance of asbestos fiber dimension (length, width) on toxicity in humans are limited. Stayner et al. (2007) evaluated the role of fiber dimension on cancer and non-cancer disease in workers exposed to chrysotile. Both lung cancer and asbestosis were most strongly associated with exposure to thin fibers (< 0.25 um). Exposure to long fibers (> 10 um) was found to be a strong predictor of increased lung cancer risk, while results for asbestosis were inconsistent. No studies of this type have been located for workers exposed to amphibole. However, Berman and Crump (2008a) performed mathematical modeling of human exposure-response data to a range of different asbestos types, and concluded that fibers < 10 um in length have very low carcinogenic potency compared to fibers longer than 10 um in length. Based on limited data on fiber width from either animal or human studies, Berman and Crump (2008a) stated that the effect of fiber width on potency remains unclear although it is likely that fiber width will affect lung cancer and mesothelioma differently.

7.4 QUANTIFICATION OF EXPOSURE AND RISK

7.4.1 Non-Cancer Risk

The basic equation for characterizing risk of a non-cancer effect from inhalation exposure to asbestos is as follows:

$$HQ = CE / RfC$$

where:

HQ = Hazard Quotient

CE = Cumulative exposure (PCM or PCME s/cc-yrs)

RfC = Reference concentration (PCM s/cc-yrs)

At present, the EPA is working to derive an RfC for inhalation exposure to LA, but this value is still under development and is not yet available for use in estimation of HQ values. Therefore, no quantitative evaluation of non-cancer risk is included in this risk assessment. However, as discussed above, studies in at the Libby Site reveal that the incidence of asbestos-related non-cancer effects, including pleural calcification, pleural thickening and opacities, are increased in workers and residents (Armstrong et al., 1988; McDonald et al., 1986; Amandus et al., 1987; Peipins et al., 2003; Muravov et al., 2005; Whitehouse, 2004). These findings emphasize that, despite the inability to provide a quantitative HQ calculation at present, risk of non-cancer effects may be of concern in the community.

7.4.2 Cancer Risk

7.4.2.1 Basic Equation

Excess lifetime risk of cancer (lung cancer plus mesothelioma) from exposure to asbestos in air is related to the amount of asbestos inhaled and the age when exposure occurs. The basic equation is (EPA 2008a):

$$Risk = EPC \cdot TWF \cdot IUR_{a,d}$$

where:

Risk = Lifetime excess risk of cancer (lung cancer or mesothelioma) as a consequence of the site-related asbestos exposure.

EPC = Exposure point concentration of asbestos in air (PCM or PCME s/cc). The EPC is an estimate of the long-term average concentration of asbestos in inhaled air.

TWF = Time weighting factor. The value of the TWF term ranges from zero to one, and describes the average fraction of full time that exposure occurs in the time interval being evaluated. The general equation is (EPA 2008a):

$$TWF = ET/24 \cdot EF/365$$

where:

ET = Average exposure time (hrs/day) on days when exposure is occurring

EF = Average exposure frequency (days/year) in years when exposure is occurring

$IUR_{a,d}$ = Inhalation unit risk $(PCM\ s/cc)^{-1}$ for an exposure that begins at age "a" and lasts for duration "d" years

The level of cancer risk that is of concern is a matter of personal, community, and regulatory judgment. In general, the EPA considers excess cancer risks that are below about 1E-06 (one in a million) to be so small as to be negligible, and risks above 1E-04 (one in ten thousand) to be sufficiently large that some sort of remediation is desirable. Excess cancer risks that range between 1E-04 and 1E-06 are generally considered to be acceptable (EPA, 1991a), although this is evaluated on a case by case basis, and EPA may determine that risks lower than 1E-04 are not sufficiently protective and warrant remedial action. As noted previously, the risks calculated here refer only to exposures that occur in OU5. EPA will perform a risk assessment at a later date that considers cumulative risks from all site-related exposure pathways.

7.4.2.2 Exposure Point Concentration

The value of the EPC term is based on TEM measurements of asbestos concentration levels in air (expressed as PCME LA s/cc) at the location of concern and for the exposure scenario of concern. Ideally, the EPC would be the true average concentration of LA in breathing zone air, averaged across the exposure duration "d". However, the true average exposure concentration can only be approximated from a finite set of measurements, and the sample mean might be either higher or lower than the true mean.

To minimize the chances of underestimating the true amount of exposure and risk, EPA generally recommends that risk calculations be based on the 95% upper confidence limit (95UCL) of the sample mean (EPA, 1992), and has developed a software application (ProUCL) to assist with the calculation of 95UCL values (EPA, 2007b). However, the equations and functions in ProUCL are not designed for asbestos concentration data sets and application of ProUCL to asbestos data sets is not recommended (EPA, 2008a). EPA is presently working to develop a new software application that will be appropriate for use with asbestos data sets, but the application is not yet available for use.

Because the 95UCL cannot presently be calculated with confidence, risk calculations presented in this report utilize the sample mean only (EPA 2008a). Because the sample mean may be either higher or lower than the true mean, the risk estimates presented here may be either higher or lower than the true risks.

In cases where the underlying data set for the EPC calculation is all non-detect, the calculated sample mean is zero. While a data set of this type provides good evidence that the true concentration is low, it is reasonable to assume the true mean value is not actually zero, although there is no reliable method for estimating what the true value might be. Therefore, in this situation, an upper-bound of the EPC was estimated based on an assumption that the true concentration is less than one structure times the mean analytical sensitivity.

7.4.2.3 Exposure Parameters

Not all individuals within a group will have equal exposures to asbestos. This is because different individuals will have differing values for exposure time (ET), exposure frequency (EF), age at first exposure (a), and exposure duration (d). To account for this variability in exposure between different individuals, EPA focuses on individuals who have central tendency exposures (CTE) and on those who have reasonable maximum exposures (RME).

Information on exposure parameters for riders at the MotoX Park was obtained from six volunteers who participated in the MotoX Park ABS investigation (EPA, 2008b). Table 7-1 presents the results of the MotoX Park survey. Risk estimates for participants at the MotoX Park are based on the exposure parameters derived from the volunteer responses.

Information on exposure parameters for indoor workers at OU5 was obtained by questionnaire in the fall of 2007 for five of the eight occupied buildings at OU5. Table 7-2 summarizes the results of this survey. For buildings where site-specific information on exposures is not available, exposure parameters were based on default values for indoor workers (EPA, 1991b; 2002; 2003b).

Exposure parameters for outdoor workers were based on default values (EPA 1991b, 2002, 2003b), but were adjusted to focus on the exposure interval when soil disturbances are occurring (i.e., a worker may be outdoors 8 hours/day, but it is unlikely that they would be disturbing soil over this entire time interval). It was assumed that outdoor workers engage in soil disturbance activities for about half the work day (i.e., 4 hours/day). In addition, because soils are likely snow-covered for a portion of the year, exposure frequency estimates were adjusted to account for days when releases due to soil disturbance activities were unlikely either due to snow cover or high soil moisture content (i.e., November to March).

Exposure parameters for recreational visitors on the bike path and MotoX spectators were based on professional judgment.

Table 7-3 presents the exposure parameters used in the OU5 risk assessment for each receptor population.

7.4.2.4 Inhalation Unit Risk (IURa,d) Values

Values of $IUR_{a,d}$ for a wide range of values for "a" (age at first exposure) and "d" (exposure duration) are provided in EPA (2008a). Table 7-3 provides the values of $IUR_{a,d}$ for each of the exposure scenarios that are evaluated in the OU5 risk assessment.

7.5 RISK CHARACTERIZATION

7.5.1 Risks to Riders and Spectators at the MotoX Park

Two ABS sampling events were performed at the OU5 MotoX Park in September 2008 (EPA 2008b). During each event, two types of air monitoring samples were collected: 1) personal air monitors were mounted to the handle bars of the motorcycles for several volunteer riders, and 2) five stationary air monitors were placed around the perimeter of the Park to characterize potential exposures to spectators. All air samples were analyzed for LA by TEM in accord with ISO 10312 (ISO 1995) counting rules, with site-specific modifications as specified in the SAP (EPA 2008b). No LA fibers were detected in any ABS air sample collected as part of the MotoX Park sampling.

Table 7-4 presents the excess cancer risk estimates for people exposed to outdoor air at the MotoX Park. In this table, risks based on CTE are in the upper panel and risks based on RME are in the lower panel. As seen, estimated cancer risks for both riders and spectators are within or below EPA's acceptable risk range. These results support the conclusion that inhalation of outdoor air at the MotoX Park is unlikely to be a source of significant excess cancer risk to either MotoX riders or spectators.

This conclusion is also supported by the fact that inspection of numerous soil samples from the MotoX Park yielded primarily non-detect results, with only a few low or trace level detects of LA or vermiculite:

MotoX Park Soil Sample Results

Method	No. Samples	Result
Visual Inspection (Qualitative)	21	17 Absent 4 Present (noted as trace)
Visual Inspection (Semi-quantitative)	630 [a]	618 None 12 Low 0 Moderate 0 High
PLM-VE	42	34 Non-detect (Bin A) 8 Trace (Bin B1)

(a) 21 soil composite samples with 30 visual inspection points per sample

7.5.2 Risks to Visitors Using the Recreational Path

Studies to evaluate exposure of bike riders on the recreational path located along the northern and eastern boundary of OU5 adjacent to Libby Creek were performed in September 2008 (EPA 2008c). On four separate days, three EPA contractors wore personal air monitors while bicycling along the entirety of the path. Sampling was conducted separately for the paved and unpaved portions of the path. On the paved path, a stationary air monitor was also mounted in a trailer attachment to one of the bicycles to characterize potential exposures to a young child being pulled by a parent. Samples from the trailer were not collected from the unpaved portion of the path because the unpaved portion of the path is steep and narrow in sections, and is not safe for pulling a trailer. All air samples were analyzed for LA by TEM in basic accord with ISO 10312 (ISO, 1995) counting rules, with site-specific modifications as specified in the SAP (EPA 2008c).

Table 7-5 presents the excess cancer risk estimates for people exposed to outdoor air while biking along the recreational path. As seen, estimated cancer risks for both adults and children are below EPA's acceptable risk range. These results support the conclusion that inhalation of outdoor air along the recreational path is unlikely to be a source of significant excess cancer risk.

7.5.3 Risks to Indoor Workers

7.5.3.1 ABS Data Summary

EPA collected indoor air samples at 20 buildings in OU5 in November/December 2007 (EPA, 2007a). For the seven OU5 buildings that were occupied, an EPA contractor wearing a personal air monitor engaged in two types of indoor worker activity scenarios, active behaviors (e.g., dusting a desk or computer, sweeping or vacuuming a floor, walking from room to room) and passive behaviors (e.g., sitting at a desk working at a computer). Each activity was conducted for approximately two hours. To avoid potential overloading, multiple air cassettes were used during the active behavior scenario over the duration of the entire sampling period.

For the 13 OU5 buildings that were vacant, five stationary air monitors were set up (one in the center of the building and one in each corner) and monitoring was performed following disturbance of the area with a leaf blower. Each stationary air sample was collected for a period of four hours following the disturbance.

All air samples were analyzed for LA by TEM in accord with ISO 10312 (ISO 1995) counting rules, with site-specific modifications as specified in the SAP (EPA, 2007a).

7.5.3.2 Exposure and Risk Calculations

To estimate potential risks for occupied buildings where site-specific survey information was not available, it was assumed that CTE workers engaged in active behaviors for approximately 50% of the work day (i.e., 4 hours/day engaged in active behaviors and 4 hours/day engaged in passive behaviors) and RME workers engaged in active behaviors for 80% of the work day.

Table 7-6 presents the excess cancer risk estimates for workers exposed to indoor air in each building that remains at the site and is within the revised boundary of OU5[2] as of June, 2010. As shown, excess cancer risk estimates are within or below EPA's acceptable risk range for all remaining sampled buildings, indicating that indoor worker exposures at these buildings are likely to be of relatively low concern.

7.5.4 Risks to Outdoor Workers from Soil Disturbances

7.5.4.1 ABS Data Summary

As part of the OU5 outdoor worker ABS investigation, sampling was conducted at eight ABS areas[3] in September/October 2008 (EPA, 2008d). Each ABS area was approximately 1-1.5 acres

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[2] Two of the 13 vacant buildings originally sampled have either burned (plywood plant) or been demolished (log yard pump house). In addition, one vacant building (boundary injection building) that was originally within the OU5 boundary is outside the current boundary of OU5.

[3] Note that ABS area 7 was within the OU5 site boundary at the time of the ABS study, but is outside the current boundary. Nevertheless, this area is retained for evaluation here, because it is considered to be representative of conditions in OU5.

in size. These eight ABS areas were selected based on previous visible vermiculite sampling results to represent the range of expected soil contamination conditions at the OU5 site, with Area 1 representing the low end of the soil range and Area 8 representing the high end of the range. At each ABS area, during each of three separate sampling events, two workers wore personal air monitors while performing an outdoor ABS "script" to simulate soil disturbance activities. The outdoor worker ABS script included a 120-minute scenario split equally into raking activities and bobcat operation activities. All air samples were analyzed for LA by TEM in accord with ISO 10312 (ISO, 1995) counting rules, with site-specific modifications as specified in the SAP (EPA, 2008d).

At each ABS area, 30 grab samples and one 30-point composite soil sample were collected within 1-2 weeks of air sampling. During the soil sample collection, the field team recorded information on visible vermiculite for each sampling point (i.e., 30 grab sampling points and 30 composite sampling points). The SAP (EPA, 2008d) called for the analysis of all of these soil samples (including both the 30 grab samples and the 30-point composite soil sample from each area at each event) by PLM-VE. However, the results from Round 1 indicated that nearly all samples at all locations were non-detect by PLM-VE. Based on this, EPA decided to perform only a visible vermiculite inspection of soil samples collected during Round 2 and Round 3, and PLM-VE analyses were placed on hold for most ABS areas (see LFO-000141 for documentation of the suspension of analysis).

Table 7-7 summarizes the results for soil samples collected as part of the Outdoor Worker ABS investigation. As noted above, based on the "original" (pre-ABS) 30-point composite soil data, it was expected that Area 1 would be at the low end of the range, and Area 8 would be at the high end of the range. As shown in Table 7-7, visual vermiculite inspection data collected around the time of the ABS sampling showed lower values and a narrower range of visible contamination levels than was expected based on the earlier soil data, but Area 8 was nevertheless at the high end of the range. The differences in the more recent visual vermiculite results compared to the original results likely arises from the inherently subjective nature of the category assignments, as well as variations in site conditions between rounds (e.g., cloud cover vs. sunshine, amount of ground cover, soil moisture, etc.).

7.5.4.2 Exposure and Risk Calculations

Table 7-8 presents excess cancer risk estimates for workers exposed to outdoor air during soil disturbance activities in each ABS area. Because all risk estimates are within or below EPA's target risk range, outdoor worker exposures to asbestos from disturbing soil in these ABS areas are likely to be of relatively low concern.

7.5.4.3 Extrapolation to Areas Without ABS Data

Operable Unit 5 encompasses about 400 acres. Because it is cost prohibitive to evaluate risks by conducting outdoor ABS sampling on every acre, it is necessary to use the ABS data from the eight ABS areas that have been investigated to draw risk conclusions about areas that have not been studied by ABS. This is achieved by assessing the degree to which soil results from other areas are similar to the soil results for areas with ABS data.

Figure 5-4 illustrates the site-wide soil contamination conditions at the OU5 site based on PLM results. A 4-color scheme is used to indicate the data: green = Bin A (non-detect), yellow = Bin B1 (trace), orange = Bin B2 (< 1%), red = Bin C (≥ 1%). Note that these color codes relate to level of LA in soil only, and do not imply either the presence or absence of risk. In this figure, individual grab samples (primarily collected within the outdoor worker ABS areas) are shown as triangles, and composite samples are shown as squares plotted at the mid-point of the area. It is important to remember that composite samples are representative of a larger area than the plotting points presented in these figures.

Figure 5-5 illustrates the site-wide soil contamination conditions at the OU5 site based on the visual vermiculite inspection results. In this figure, historical observations of visible vermiculite which utilized a qualitative present/absent approach are shown as triangles. More recent visible vermiculite observations which utilized a semi-quantitative approach are shown as squares and are color-coded based on the visible score (see Section 3.2.2). A 4-color scheme is used to indicate the visible score data: green = score of 0 (no visible detected), yellow = score < 0.1, orange = score 0.1 to < 0.3, red = score > 0.3. Note that these color codes relate to level of visible vermiculite in soil only, and do not imply either the presence or absence of risk.

One potential limitation to the approach for presenting the visible score data is that the choice of cut-offs for use in color-coding is arbitrary. If other cut-offs were chosen, the appearance of the figures would be different. Nevertheless, the figures do provide a useful indication of the degree to which there is variation across the site and the locations where higher than average levels have been observed.

As shown in Figure 5-4, PLM results are generally non-detect or trace across the OU5 Site. The one location where PLM results have consistently been higher (with observed LA levels up to 1%) is the former Tree Nursery area. This location also has elevated visible scores (see Figure 5-5).

The Outdoor Worker ABS program specifically targeted this area (ABS Area #8) to be representative of a location with the highest expected levels of contamination at OU5. As seen in Table 7-8, the estimated cancer risks to workers in all ABS areas, including ABS Area #8, are below or within EPA's acceptable risk range. This suggests that other locations at the OU5 Site with soil contamination levels that are similar to or less than those evaluated as part of the ABS program are also likely to be within EPA's acceptable risk range.

7.5.5 Risks to Outdoor Workers from Waste Bark Pile Disturbances

As noted previously, there are several large waste bark piles located in OU5. In October 2007, a qualitative analysis of materials from these piles showed that LA was present. At the time of this pile sampling, test excavations were performed to investigate whether disturbance of these piles was of concern to outdoor workers (CDM, 2007b). Several personal air samples were collected from the excavator operator and soil sampling personnel during the test pit excavations. A total of 4 air samples (2 individuals * 2 samples per individual) were collected and analyzed for LA by TEM in basic accord with ISO 10312 (ISO, 1995) counting rules. No LA structures were detected in any air sample collected as part of the Waste Bark activity.

Table 7-9 presents excess cancer risk estimates for workers exposed to outdoor air during waste bark pile disturbance activities. As seen, estimated cancer risks are within EPA's acceptable risk range. These results support the conclusion that inhalation of outdoor air near disturbances of the waste bark piles is unlikely to be a source of significant excess cancer risk to outdoor workers.

7.5.6 Risks from Outdoor Ambient Air

All people who visit or work at OU5 will be exposed by breathing outdoor ambient air (outdoor air that is not impacted by personal activities that disturb LA in outdoor soil). Although an outdoor ambient air monitoring program has not been performed specifically to characterize air at OU5, EPA has performed an extensive study of outdoor ambient air in Libby from October 2006 to June 2008, using 14 different monitoring stations distributed throughout the Libby community, including one station within OU5. The results of this study are presented in EPA (2009). The average concentration of LA in ambient air was low at all stations, ranging from 2.3E-06 to 9.2E-06 PCME s/cc, depending upon the monitoring location. The mean value for the station in OU5 was 4.5E-06 PCME s/cc.

EPA (2009) used these data to calculate risks from inhalation of ambient air, assuming exposure of 8 hours/day, 200 days/year, for 50 years, starting at age 0. These exposure assumptions are likely to be higher than actual exposure patterns for either visitors or workers at the OU5 site. Resulting risk estimates from inhalation of LA in outdoor ambient air ranged from 1E-07 to 4E-07, below EPA's acceptable risk range of 1E-04 to 1E-06, indicating that inhalation exposure to outdoor ambient air, taken alone, is not of significant concern for workers or visitors at OU5.

7.5.7 Summary and Conclusions

Cancer risk estimates based on measured LA concentrations in air are within or below EPA's risk range for indoor and outdoor workers, as well as recreational visitors along the bike path and at the MotoX Park. These results suggest that recreational and occupational exposures at OU5 are likely to be of low concern. However, it is important to note that most people who visit or work at OU5 are likely to be exposed to LA by a number of different exposure pathways, and that risk management decision-making should consider the sum of the risks across all pathways, not just those evaluated in this report.

7.6 UNCERTAINTIES

There are a number of uncertainties that arise during the process of estimating human exposure and risk to asbestos, and these uncertainties limit the confidence in the estimated risks to people who may visit or work at OU5. The principal sources of this uncertainty are discussed below.

7.6.1 Uncertainty in LA Levels in Soil

As discussed previously, characterization of LA levels in soil is difficult. At present, the best available techniques are PLM-VE and visible inspection for vermiculite. However, both methods are subjective and are only semi-quantitative, and both tend to be somewhat variable between repeat analyses. Thus, the results of PLM or visible inspections analyses should be understood to be uncertain. In addition, because the relationship between LA levels in soil and in air is not understood, measures of LA in soil by PLM-VE or visible inspection must not be confused with estimates of potential health risk.

7.6.2 Uncertainty in LA Concentrations in Inhaled Air

Concentrations of LA in air are inherently variable, so estimates of mean exposure concentrations are subject to uncertainty arising from random variation between individual samples. This problem is especially marked for ABS samples, where very wide variability (3-4 orders of magnitude) may be observed within and between data sets. This high variability means that it is usually necessary to collect a large number of samples to ensure that the data are representative.

However, as noted above, only a limited number of ABS values are available for each ABS area, and these values may not be representative of the true long term average exposure concentration for soil disturbances in the OU. Consequently, the observed sample mean concentration may be either higher or lower than the true mean.

This uncertainty is further compounded by the effect of analytical measurement error. That is, for each air sample collected, the measured concentration value is a random variable that is characterized by the Poisson distribution:

$$C_{observed} \sim \text{POISSON}\ (C_{true} \cdot \text{Volume Analyzed}) \ / \ \text{Volume Analyzed}$$

As a consequence, the total variability (and hence uncertainty) in the measured concentration values is greater than the variability due to sampling variation alone. Consequently, risks calculated based on the mean may be either higher or lower than the true risk, but the magnitude of the potential error cannot be estimated because appropriate statistical methods are not yet available to calculate the 95UCL.

7.6.3 Uncertainty Arising from Use of an Indirect Preparation Technique

During TEM analysis of the ABS air samples, the analytical laboratories noted that some of the air filters were significantly overloaded with particulates. As a result, these samples were analyzed using an indirect preparation method after ashing. For chrysotile asbestos, indirect preparation often tends to increase structure counts due to dispersion of bundles and clusters (Hwang and Wang, 1983; HEI-AR, 1991; Breysse 1991). For amphibole asbestos, the effects of indirect preparation are generally much smaller (Bishop et al., 1978; Sahle and Laszlo, 1996; Harris 2009). Based on this, it is expected that the effect of indirect preparation on estimates of LA concentrations in air is likely to be minor.

This expectation is supported by a Libby-specific study conducted in 2005. This study compared the results for 31 samples analyzed for LA using both direct and indirect preparation methods (EPA, 2007c). Figure 7-3 presents the paired results from this study. For total LA (Panel A), some samples were statistically lower, some were not statistically different, and some were statistically higher when analyzed by an indirect method compared to a direct method. Although the difference was 10- to15-fold in a few samples, the average across all samples was about 3.3. A similar pattern is observed when results are expressed as PCME s/cc (Panel B), although the differences tend to be smaller. In this case, the average ratio of indirect to direct concentration estimates is about 1.5. Based on these considerations, it is concluded that analysis of samples for LA using an indirect preparation method may tend to overestimate exposure and risk somewhat, but that the magnitude of the error is not likely to exceed a factor of about 1.5-3.

7.6.4 Lack of an Approved Non-Cancer Inhalation RfC

As discussed in Section 7.3.1, EPA has not yet developed national guidance for evaluating the risk of non-cancer effects from inhalation exposure to asbestos. For most chemicals that cause both cancer and non-cancer effects, it is usually true that unacceptable risks from cancer occur at lower environmental exposure levels than unacceptable risks of non-cancer effects. In this case, if action is taken to protect humans from unacceptable cancer risk, concern over non-cancer risk is generally low. In this event, absence of a reliable inhalation RfC might have little effect on risk management decision-making. However, this may not be the case for LA. Studies of former workers at the vermiculite mine and residents of Libby (Armstrong et al., 1988; McDonald et al., 1986a, 1986b; Amandus et al., 1987; Peipins et al., 2003; Muravov et al., 2005; Whitehouse 2004) provide strong evidence that exposure to LA results in an increased incidence of non-cancer adverse effects, and that these effects occur in some individuals who appear to have relatively low exposures. Similar results have been observed in workers at a plant in Ohio that utilized vermiculite from Libby to make lawn care products (Lockey et al. 1984, Rohs et al. 2008). Thus, it should not necessarily be presumed that cancer risk is the “risk driver” at Libby OU5 or other parts of the Libby Site.

7.6.5 Uncertainty in Human Exposure Patterns

Risk from asbestos is strongly dependent not only on the level of exposure, but also on the time and frequency of exposure and on the age when exposure begins and ends. Exposure parameters for some site users (recreational visitors at the MotoX Park and indoor workers at occupied buildings) were based on site-specific survey information, while exposures for other populations are based on EPA default values or professional judgment. However, there is uncertainty in these exposure parameters, so actual exposures might be either higher or lower than estimated.

7.6.6 Uncertainty in the Cancer Exposure-Response Relationship

Although the Integrated Risk Information System (IRIS) method is currently the only approach approved by EPA for estimating cancer risks from inhalation of asbestos (EPA 2008a), there are some uncertainties and potential limitations to the use of this method, as follows:

- The potency factors derived by EPA (1986) are based on measures of exposure expressed as PCM fibers, without any distinction of mineral type (chrysotile, amphibole). However, there are a number of studies which suggest that mineral type may be an important determinant of potency, at least for mesothelioma. Because the potency factors are consensus values that are derived from studies that include occupational exposures to chrysotile alone, amphibole alone, and a mixture of amphibole and chrysotile, it is expected that the IRIS potency factors are intermediate between the values for amphibole and chrysotile. To the extent that amphibole is more potent that chrysotile, use of the IRIS potency factors may tend to underestimate risks in Libby, where the mineral form of concern is amphibole.
- To the extent that the particle size distributions vary between workplaces (i.e., the ratio is not constant between the concentration of PCM fibers and the concentrations of other size ranges with differing potencies), the IRIS approach cannot account for these differences, and may either underestimate or overestimate risk.
- The IRIS values are based on observations in workers, and may not address differences in susceptibility between different types of populations (e.g., children, the elderly).
- The IRIS values represent the central tendency estimates of the potency factors, not an upper bound on the values. Thus, the true potency factors might be either higher or lower than the values selected.
- The unit risks derived by EPA (1986) are based on mortality statistics from the 1970's. Thus, they may not be applicable to populations that are exposed to asbestos today. In particular, as life expectancy has increased, risks from asbestos exposure also tend to increase. Thus, risk estimates based on the IRIS method may be somewhat low.

Because of these potential limitations, risk estimates were derived using two alternative methods. Although neither of these alternative methods is currently approved for use by EPA, the results do provide some information on the range of model uncertainty in cancer risk predictions. These alternative methods are described briefly below.

1. Updated IRIS Approach. This is the same basic risk model as the standard EPA IRIS risk model, except that unit risk values are updated using more recent population mortality statistics. This model is based on PCM (or PCME) exposures, and does not distinguish between amphibole and chrysotile asbestos.
2. Berman and Crump (2008b). This model is based on fitting existing epidemiological studies to a model that seeks to distinguish potency as a function of asbestos type (chrysotile vs amphibole) and fiber size (length, thickness). The authors found that amphibole was more potent than chrysotile, and that long fibers (>10 um) were more potent than short fibers. Risk calculations are based on fibers longer than 10 um, distinguishing between amphibole and chrysotile.

Figure 7-4 shows the risk from LA predicted by each of these models compared to the risk predicted by the standard IRIS model. As seen, both of the alternative models predict risks that are somewhat higher than the IRIS risk model. The difference is relatively small (about 20%) for the updated IRIS model, and is about a factor of 3 for the Berman and Crump model. As noted above, EPA does not depend on any of these models for decision-making, but the results are consistent with the view that the risk estimates derived using the IRIS method maybe somewhat low for exposures to LA at OU5.

7.6.7 Uncertainty Associated with Cumulative Exposures

Most people who live or work in Libby may be exposed to LA by a number of different pathways. Because this risk assessment evaluates only some of these pathways, the risk estimates presented here are likely to underestimate the total risks to some people.

However, until risk assessments are completed for all potentially significant exposure pathways, the magnitude of the risks cannot be reliably estimated.

8.0 CONCLUSIONS

The RI reached the following general conclusions:

1. PLM results for surface soil samples are generally non-detect or trace across OU5. The one location where PLM results have consistently been higher (with observed LA levels up to 1%) is the former Tree Nursery area. This location also has elevated visible vermiculite scores.

2. PLM and visible vermiculite results for subsurface soil samples are generally non-detect. These results suggest that no increasing vertical gradient in LA or vermiculite occurrence exists in the areas examined. However, subsurface soil sampling across OU5 is limited.

3. Predicting the LA levels in air associated with disturbance activities based only on measured LA levels in the source material is extremely difficult. Therefore, ABS is considered to be the most direct way to estimate potential exposures from inhalation of asbestos.

4. Exposure pathways that are thought to be most likely of potential concern in OU5 include:

    - Exposure of indoor workers to residual LA in indoor air of existing buildings.
    - Exposure of outdoor workers to residual contamination in outdoor soil.
    - Exposure of motorcycle riders and spectators at the MotoX Park.
    - Exposure of bicycle riders along the recreational trail.

5. ABS air sampling was conducted in all existing buildings (as of June 2010) except the Finger Jointer Processing Plant. Excess cancer risk estimates are within or below EPA's acceptable risk range for all sampled buildings, indicating that indoor worker exposures at these buildings are likely to be of relatively low concern.

6. Cancer risk estimates for workers exposed to outdoor air during soil disturbance activities in each ABS area are within or below EPA's target risk range. Therefore, outdoor worker exposures to asbestos from disturbing soil in these ABS areas are likely to be of relatively low concern.

7. Estimated cancer risks for both riders and spectators at the MotoX Park are within or below EPA's acceptable risk range. These results support the conclusion that inhalation of outdoor air at the MotoX Park is unlikely to be a source of significant excess cancer risk to either MotoX riders or spectators.

8. Estimated cancer risk estimates for both adults and children exposed to outdoor air while biking along the recreational path are below EPA's acceptable risk range. These results

support the conclusion that inhalation of outdoor air along the recreational path is unlikely to be a source of significant excess cancer risk.

9. Estimated cancer risks for workers exposed to outdoor air during waste bark pile disturbance activities are within EPA's acceptable risk range. These results support the conclusion that inhalation of outdoor air near disturbances of the waste bark piles is unlikely to be a source of significant excess cancer risk to outdoor workers.

10. At present, the EPA is working to derive an RfC for inhalation exposure to LA, but this value is still under development and is not yet available for use in estimation of HQ values. Therefore, no quantitative evaluation of non-cancer risk is included in the risk assessment.

11. An ecological risk assessment is being developed for the mine site (OU3). EPA will build upon the information gathered during that ecological risk assessment to identify potential pathways and receptors to evaluate ecological risk at OU5. If ecological exposure pathways are identified at OU5, an ecological risk assessment will be performed.

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Tables

TABLE 1-1
Response Actions Taken at OU5

Location	Date	Lead Agency/Company	Description
Plywood Plant and Truck Shop	November 1999	MCS Environmental through Stimson Lumber Company	Asbestos abatement
Finger Jointer	May 2000	MCS Environmental through Stimson Lumber Company	Removal of vermiculite insulation from lunch room and bathroom
Dry Kiln Tunnel	December 2002	IRS Environmental through Stimson Lumber Company	Removal of pipe insulation and asbestos containing debris
Central Maintenance Building	May/June 2003	IRS Environmental through Stimson Lumber Company	Removal of vermiculite insulation and asbestos containing materials on ground surface
Plywood Dryers	August 2003	IRS Environmental through Stimson Lumber Company	Removal of vermiculite insulation from walls, floors, and ceilings
Plywood Plant	August 2003	IRS Environmental through Stimson Lumber Company	Removal of pipe insulation of northwest corner
Screening Building	August 2003	IRS Environmental through Stimson Lumber Company	Removal of cement asbestos siding and roofing
Central Maintenance Building	December 2003	IRS Environmental through Stimson Lumber Company	Removal and repair of asbestos containing roofing material and asbestos containing materials on ground surface
Former Nursery	Fall 2004	EPA	Installation of fence to isolate area
Finger Jointer Lunch Room	February 2005	IRS Environmental through Stimson Lumber Company	Removal of vermiculite insulation
Central Maintenance Building	Summer 2005	EPA	Removal of vermiculite insulation
Soils northwest of Pipe Shop to support redevelopment	Spring and Summer 2009	EPA	Removal of LA-impacted soils to depths of 6”-18” to support Site redevelopment.
Libby Creek (OU4 action w/possible encroachment on OU5)	August 2009	EPA	Removal and replacement of rip-rap on east bank of Libby Creek

Source: CDM (2007) OU5, Final Data Summary Report – October 16, 2007

TABLE 3-1
Sampling Events at OU5

Location	Date	Investigation Description	Media Collected and Analyzed	Reason for Selecting Sample Location
Former Nursery	May 2002	Phase I Investigation	Dust	Investigative
OU5 Site-wide	September/ October 2002	Contaminant Screening Study (including building inspections)	Air, personal Air, stationary Dust Soil	Non-discriminatory grid based sampling
MotoX Track	May 2004	Soil sampling	Soil	High use area
Central Maintenance Building	April/May, August 2004	Pre-design inspection; soil, dust, and bulk insulation sampling	Soil Dust Bulk	Building contains vermiculite based materials
Proposed Demolition Derby Area	July 2004	Soil sampling	Soil	High use area
Former Nursery	June 2005	Soil and air sampling to correlate soil contamination with airborn fibers.	Air, personal Air, stationary Soil	Location was suspected to have vermiculite in soils and was therefore a suitable location.
OU5 Monitoring Station	October 2006 to September 2007	Libby ambient air monitoring	Air, stationary	Aimed to determine general background asbestos concentration levels at site
OU5 Site-wide	October 2007	Soil data gap sampling	Soil	Collect samples from areas not previously investigated.
Wood Chip/Waste Bark Piles	October 2007	Wood chip/waste bark pile sampling; outdoor worker activity-based sampling	Air, personal Soil Waste bark Wood chips	Waste bark stored on site may contain asbestos and traveled to site

Note: Excludes worker air samples collected as part of OSHA requirements that were analyzed by AHERA

Source: Based on a download of the Libby2DB performed 12/9/09

TABLE 3-1 (continued)
Sampling Events at OU5

Location	Date	Investigation Description	Media Collected and Analyzed	Reason for Selecting Sample Location
Various OU5 Buildings	November 2007 to January 2008	Indoor worker activity-based sampling	Air, personal Air, stationary Dust	Estimate LA exposure to workers
OU5 Site-wide	June/July 2008	Soil data gap addendum sampling	Air, personal Soil	Collect samples from areas not previously investigated.
MotoX Track	September 2008	Outdoor recreational activity-based sampling	Air, personal Air, stationary Soil	Estimate LA exposure to recreational users
Bicycle & Hiking Trail near Libby Creek	September 2008	Outdoor recreational activity-based sampling	Air, personal	Estimate LA exposure to recreational users
OU5 Site-wide	September/ October 2008	Outdoor worker activity-based sampling	Air, personal Soil Vegetation	Estimate LA exposure to workers
Landfarm	October 2008	Landfarm soil sampling	Soil	Area of Groundwater Superfund Site not previously sampled
OU5 Re-development Zones	April 2009	Re-development soil sampling	Soil	EPA requested to do re-development plans
Libby Creek Driveway	April 2009	Pre-design inspection; soil	Soil	EPA requested to do re-development plans

Note: Excludes worker air samples collected as part of OSHA requirements that were analyzed by AHERA

Source: Based on a download of the Libby2DB performed 12/9/09

TABLE 3-2

Visible Vermiculite Inspection Scores and Selected Locations for Outdoor Worker ABS

Area	Visible Inspection Results				Score	Category
	None	Low	Med	High		
1	30				0.00	None
2	30				0.00	None
3	28	2			0.07	Low
4	28	2			0.07	Low
5	26	4			0.13	Medium
6	26	4			0.13	Medium
7	21	8	1		0.37	High
8	6	20	3	1	1.30	High

See Figure 3-1 for ABS Area locations

TABLE 7-1
Moto-X Park Activity Survey Results

Participant	Reported Survey Results					Estimated Exposure Parameter Values†			
	d/yr @ track	hr/d @ track	hr/d riding	age @ start	age @ end	EF (d/yr)	ET* (hr/d)	age @ start (yrs)	ED (yrs)
1	21-30	3-4	1-2	26-30	61-70	**25**	**1.5**	**28**	**37**
2	31-50	1-2	1-2	15-20	41-50	**40**	**1.5**	**18**	**27.5**
3	21-30	3-4	1-2	36-40	51-60	**25**	**1.5**	**38**	**17**
4	31-50	3-4	1-2	15-20	41-50	**40**	**1.5**	**18**	**27.5**
5	21-30	1-2	0.5-0.9	15-20	>70	**25**	**0.75**	**18**	**52.5**
6	21-30	3-4	3-4	21-25	>70	**25**	**3.5**	**23**	**47**
					CTE (mean):	**30**	**2**	**24**	**35**
					RME (min or max):	**40**	**4**	**18**	**53**

† Based on midpoint of reported range
* Based on reported time spent riding

TABLE 7-2
Indoor Worker Activity Survey Summary

Panel A: CTE (Based on mean values)

OU5 Building Location	N surveyed	% of Time Active	ET (hr/d)	EF (d/yr)	Age at Start (yrs)	Duration (yrs)
CMB - B&C Pkg	5	100	6.20	180	23	2
CMB - other	17	85	3.0	146	33	11
Luck EG Shed	3	100	0.22	280	35	8
Luck EG Office	1	50	6.0	220	39	10
Scale House	8	100	0.07	9	29	13
CDM Office Type 1 (a)	10	5	8.0	250	35	10
CDM Office Type 2 (a)	20	5	4.0	280	25	10
CDM Office Type 3 (a)	30	5	1.0	250	25	10

Panel B: RME (Based on high-end values)

OU5 Building Location	N surveyed	% of Time Active	ET (hr/d)	EF (d/yr)	Age at Start (yrs)	Duration (yrs)
CMB - B&C Pkg	5	100	1.00	300	18	5
CMB - other	17	100	8.0	319	18	27
Luck EG Shed	3	100	0.33	300	21	15
Luck EG Office	1	--	--	--	--	--
Scale House	8	100	0.08	10	20	25

(a) Mean statistics provided by CDM

CMB = central maintenance building
ET = exposure time
EF = exposure frequency

TABLE 7-3
Exposure Parameters and Inhalation Unit Risk Values

Panel A: CTE

Exposure Scenario	Exposure Time (ET)		Exposure Frequency (EF)		Age at Exposure Start (a)		Exposure Duration (d)		Time-Weighting Factor (TWF)	Inhalation Unit Risk ($IUR_{a,d}$)
	hr/d	Source	d/yr	Source	yr	Source	yrs	Source	unitless	$(PCM\ s/cc)^{-1}$
Recreational Visitor										
MotoX Participant	2	a	30	a	25	a	35	a	0.0068	0.06
MotoX Spectator	4	b	30	b	15	b	45	b	0.014	0.11
Bicyclist on Bike Path (adult)	1	b	24	d	15	b	45	b	0.0027	0.11
Bicyclist on Bike Path (child)	1	b	24	d	0.5	b	6	b	0.0027	0.054
Worker										
General outdoor laborer	4	[2]e	131	[3]f	20	b	10	b	0.060	0.039
General indoor laborer	8	[2]	219	[3]	20	b	10	b	0.20	0.039

Source Citations:

[1] EPA. 2002. Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. U.S. Environmental Protection Agency, Office of Solid Waste and Emergency

[2] EPA. 1991. Risk Assessment Guidance for Superfund. Volume I. Human Health Evaluation Manual. Supplemental Guidance: "Standard Default Exposure Factors". U.S.

[3] EPA. 2003. Recommendations of the Technical Review Workgroup for Lead for an Approach to Assessing Risks Associated with Adult Exposures to Lead. Final. EPA-540-R

Source Notes:

a) estimated based on site-specific questionnaire

b) assumed value based on professional judgment

c) assumed to be CTE * 2

d) assumed to be 1 time per weekend for 6 months (April - September)

e) default of 8 hrs/day adjusted by a factor of 0.5 to account for time spent disturbing soil

f) default of 219 days/yr (CTE) or 225 days/yr (RME) adjusted by a factor of 0.6 to account for fraction of time when soils are covered by snow (Nov - Mar)

TABLE 7-3 (continued)
Exposure Parameters and Inhalation Unit Risk Values

Panel B: RME

Exposure Scenario	Exposure Time (ET)		Exposure Frequency (EF)		Age at Exposure Start (a)		Exposure Duration (d)		Time-Weighting Factor (TWF)	Inhalation Unit Risk ($IUR_{a,d}$)
	hr/d	Source	d/yr	Source	yr	Source	yrs	Source	unitless	$(PCM\ s/cc)^{-1}$
Recreational Visitor										
MotoX Participant	4	a	40	a	15	a	55	a	0.018	0.11
MotoX Spectator	4	b	60	c	15	b	45	b	0.027	0.11
Bicyclist on Bike Path (adult)	2	c	48	c	15	b	45	b	0.011	0.11
Bicyclist on Bike Path (child)	2	c	48	c	0.5	b	6	b	0.011	0.054
Worker										
General outdoor laborer	4	[2]e	135	[1]f	20	b	25	[1]	0.062	0.069
General indoor laborer	8	[2]	250	[1]	20	b	25	[1]	0.23	0.069

<u>Source Citations:</u>

[1] EPA. 2002. Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. U.S. Environmental Protection Agency, Office of Solid Waste and Emergency

[2] EPA. 1991. Risk Assessment Guidance for Superfund. Volume I. Human Health Evaluation Manual. Supplemental Guidance: "Standard Default Exposure Factors". U.S.

[3] EPA. 2003. Recommendations of the Technical Review Workgroup for Lead for an Approach to Assessing Risks Associated with Adult Exposures to Lead. Final. EPA-540-R

<u>Source Notes:</u>

a) estimated based on site-specific questionnaire

b) assumed value based on professional judgment

c) assumed to be CTE * 2

d) assumed to be 1 time per weekend for 6 months (April - September)

e) default of 8 hrs/day adjusted by a factor of 0.5 to account for time spent disturbing soil

f) default of 219 days/yr (CTE) or 225 days/yr (RME) adjusted by a factor of 0.6 to account for fraction of time when soils are covered by snow (Nov - Mar)

Table 7-4
MotoX Exposure Point Concentrations and Risk Calculations

Panel A: CTE

Receptor Type	EPC PCME f/cc	ET hrs/day	EF days/yr	a yrs	d yrs	TWF --	$IUR_{a,d}$ $(PCM\ f/cc)^{-1}$	Risk
Participant	< 0.0098	2	30	25	35	0.007	0.063	< 4E-06
Spectator	< 0.0011	4	30	15	45	0.014	0.11	< 2E-06

Panel B: RME

Receptor Type	EPC PCME f/cc	ET hrs/day	EF days/yr	a yrs	d yrs	TWF --	$IUR_{a,d}$ $(PCM\ f/cc)^{-1}$	Risk
Participant	< 0.0098	4	40	15	55	0.018	0.11	< 2E-05
Spectator	< 0.0011	4	60	15	45	0.027	0.11	< 3E-06

TABLE 7-5

Recreational Visitor Exposure Point Concentrations and Risk Calculations

Panel A: CTE

		EPC	ET	EF	a	d	TWF	$IUR_{a,d}$	Risk
Receptor	Location	PCME LA f/cc	hrs/day	days/yr	yrs	yrs	unitless	$(PCM\ f/cc)^{-1}$	
Adult	Unpaved/Paved	9.5E-05	1	24	15	45	0.0027	0.11	3E-08
Child	Trailer (Paved)	1.3E-04	1	24	0.5	6	0.0027	0.05	2E-08

Panel B: RME

		EPC	ET	EF	a	d	TWF	$IUR_{a,d}$	Risk
Receptor	Location	PCME LA f/cc	hrs/day	days/yr	yrs	yrs	unitless	$(PCM\ f/cc)^{-1}$	
Adult	Unpaved/Paved	9.5E-05	2	48	15	45	0.011	0.11	1E-07
Child	Trailer (Paved)	1.3E-04	2	48	0.5	6	0.011	0.05	8E-08

TABLE 7-6
Indoor Worker Exposure Point Concentrations and Risk Calculations

Panel A: CTE

Building Type	Building Name	EPC (PCME LA f/cc) Active		EPC (PCME LA f/cc) Passive		% of Time Active	ET hrs/day	EF days/yr	a yrs	d yrs	TWF --	$IUR_{a,d}$ $(PCM\ f/cc)^{-1}$	Risk	
Occupied	CMB, B+C Packaging		2.4E-04	<	4.9E-04	100%	6	180	23	2	0.127	0.010	<	3E-07
	Bioreactor Building		2.3E-04	<	4.9E-04	50%	8	219	20	10	0.200	0.039	<	3E-06
	CDM Main Office[a]		3.2E-03	<	4.9E-04	5%	8	250	35	10	0.228	0.021	<	3E-06
	Central Maintenance Building		2.6E-03		5.3E-04	85%	3	146	33	11	0.049	0.024		3E-06
	Fire Hall	<	6.3E-03	<	4.9E-04	50%	8	219	20	10	0.200	0.039	<	3E-05
	Log Yard Truck Scale House		1.6E-02	<	5.0E-04	100%	0.07	9	29	13	0.000	0.033	<	4E-08
	Luck EG Electric Motor Shed		5.0E-03	<	4.5E-04	100%	0.22	280	35	8	0.007	0.019	<	7E-07
	Office/Laboratory		2.5E-04	<	4.9E-04	50%	8	219	20	10	0.200	0.039	<	3E-06
Vacant	Chemical Storage Building	<	4.9E-04		--	[b]	8	219	20	10	0.200	0.039	<	4E-06
	Diesel Fire Pump House		2.8E-04		--	[b]	8	219	20	10	0.200	0.039		2E-06
	Electric Pump House		8.4E-04		--	[b]	8	219	20	10	0.200	0.039		7E-06
	Intermediate Injection Building	<	4.8E-04		--	[b]	8	219	20	10	0.200	0.039	<	4E-06
	LTU Leachate Building #1		9.7E-05		--	[b]	8	219	20	10	0.200	0.039		8E-07
	LTU Leachate Building #2	<	4.9E-04		--	[b]	8	219	20	10	0.200	0.039	<	4E-06
	Pipe Shop	<	2.2E-03		--	[b]	8	219	20	10	0.200	0.039	<	2E-05
	Power house/office	<	9.1E-04		--	[b]	8	219	20	10	0.200	0.039	<	7E-06
	Shed 12	<	4.9E-04		--	[b]	8	219	20	10	0.200	0.039	<	4E-06
	Tank Farm Building	<	4.9E-04		--	[b]	8	219	20	10	0.200	0.039	<	4E-06

(shaded) Exposure parameters based on site-specific survey results (see Table 7-2)

Notes:

[a] Exposure parameters based on CDM Office worker Type 1

[b] Only active ABS data available; risk estimates assume 100% of time is active

CMB = Central Maintenance Building

TABLE 7-6 (continued)
Indoor Worker Exposure Point Concentrations and Risk Calculations

Panel B: RME

Building Type	Building Name	EPC (PCME LA f/cc)		% of Time	ET	EF	a	d	TWF	$IUR_{a,d}$	
		Active	Passive	Active	hrs/day	days/yr	yrs	yrs	--	$(PCM f/cc)^{-1}$	Risk
Occupied	CMB, B+C Packaging	2.4E-04	< 4.9E-04	100%	7	180	18	5	0.144	0.024	< 8E-07
	Bioreactor Building	2.3E-04	< 4.9E-04	80%	8	250	20	25	0.228	0.069	< 5E-06
	CDM Main Office	3.2E-03	< 4.9E-04	80%	8	250	20	25	0.228	0.069	< 4E-05
	Central Maintenance Building	2.6E-03	5.3E-04	100%	8	329	17	31	0.315	0.084	7E-05
	Fire Hall	< 6.3E-03	< 4.9E-04	80%	8	250	20	25	0.228	0.069	< 8E-05
	Log Yard Truck Scale House	1.6E-02	< 5.0E-04	100%	0.08	10	20	25	0.000	0.069	< 1E-07
	Luck EG Electric Motor Shed	5.0E-03	< 4.5E-04	100%	0.33	300	21	15	0.011	0.050	< 3E-06
	Office/Laboratory	2.5E-04	< 4.9E-04	80%	8	250	20	25	0.228	0.069	< 5E-06
Vacant	Chemical Storage Building	< 4.9E-04	--	[b]	8	250	20	25	0.228	0.069	< 8E-06
	Diesel Fire Pump House	2.8E-04	--	[b]	8	250	20	25	0.228	0.069	4E-06
	Electric Pump House	8.4E-04	--	[b]	8	250	20	25	0.228	0.069	1E-05
	Intermediate Injection Building	< 4.8E-04	--	[b]	8	250	20	25	0.228	0.069	< 8E-06
	LTU Leachate Building #1	9.7E-05	--	[b]	8	250	20	25	0.228	0.069	2E-06
	LTU Leachate Building #2	< 4.9E-04	--	[b]	8	250	20	25	0.228	0.069	< 8E-06
	Pipe Shop	< 2.2E-03	--	[b]	8	250	20	25	0.228	0.069	< 3E-05
	Power house/office	< 9.1E-04	--	[b]	8	250	20	25	0.228	0.069	< 1E-05
	Shed 12	< 4.9E-04	--	[b]	8	250	20	25	0.228	0.069	< 8E-06
	Tank Farm Building	< 4.9E-04	--	[b]	8	250	20	25	0.228	0.069	< 8E-06

Exposure parameters based on site-specific survey results (see Table 7-2)

Notes:

[a] Exposure parameters based on CDM Office worker Type 1

[b] Only active ABS data available; risk estimates assume 100% of time is active

CMB = Central Maintenance Building

Table 7-7
Detailed Results for OU5 Outdoor Worker ABS Soil Samples

		30-point composite							30 individual grabs									
	ABS	Visible Vermiculite						PLM	Visible Vermiculite						PLM Result			
Area	Round	ND	L	M	H	DF	Score	Result	ND	L	M	H	DF	Score	ND	Tr	<1	DF
1	original	30	0	0	0	0	0.00	--	--	--	--	--	--	--	--	--	--	--
	1	30	0	0	0	0	0.00	ND	30	0	0	0	0	0.00	30	0	0	0
	2	29	1	0	0	0.03	0.03	--	30	0	0	0	0	0.00	--			
	3	30	0	0	0	0	0.00	--	30	0	0	0	0	0.00	--			
	all (1-3)	89	1	0	0	0.01	0.01		90	0	0	0	0	0.00	30	0	0	0
2	original	30	0	0	0	0	0.00	--	--	--	--	--	--	--	--	--	--	--
	1	30	0	0	0	0	0.00	ND	30	0	0	0	0	0.00	30	0	0	0
	2	30	0	0	0	0	0.00	ND	30	0	0	0	0	0.00	30	0	0	0
	3	30	0	0	0	0	0.00	ND	29	0	0	0	0	0.00	30	0	0	0
	all (1-3)	90	0	0	0	0	0.00		89	0	0	0	0	0.00	90	0	0	0
3	original	28	2	0	0	0.07	0.07	--	--	--	--	--	--	--	--	--	--	--
	1	29	1	0	0	0.03	0.03	ND	29	1	0	0	0.03	0.03	30	0	0	0
	2	30	0	0	0	0	0.00	ND	28	1	0	0	0.03	0.03	9	0	0	0
	3	30	0	0	0	0	0.00	--	30	0	0	0	0	0.00	--			
	all (1-3)	89	1	0	0	0.01	0.01		87	2	0	0	0.02	0.02	39	0	0	0
4	original	28	2	0	0	0.07	0.07	--	--	--	--	--	--	--	--	--	--	--
	1	30	0	0	0	0	0.00	ND	28	2	0	0	0.07	0.07	30	0	0	0
	2	30	0	0	0	0	0.00	--	30	0	0	0	0	0.00	--			
	3	30	0	0	0	0	0.00	--	30	0	0	0	0	0.00	--			
	all (1-3)	90	0	0	0	0	0.00		88	2	0	0	0.02	0.02	30	0	0	0
5	original	26	4	0	0	0.13	0.13	--	--	--	--	--	--	--	--	--	--	--
	1	30	0	0	0	0	0.00	ND	28	2	0	0	0.07	0.07	30	0	0	0
	2	31	0	0	0	0	0.00	ND	30	0	0	0	0	0.00	30	0	0	0
	3	30	0	0	0	0	0.00	ND	30	0	0	0	0	0.00	30	0	0	0
	all (1-3)	91	0	0	0	0	0.00		88	2	0	0	0.02	0.02	90	0	0	0

Original visible vermiculite results provided in the Outdoor Worker ABS SAP (USEPA 2008b; Table 3-1).

-- = no PLM-VE analysis was performed

Table 7-7 (continued)
Detailed Results for OU5 Outdoor Worker ABS Soil Samples

Area	ABS Round	30-point composite: Visible Vermiculite ND	L	M	H	DF	Score	PLM Result	30 individual grabs: Visible Vermiculite ND	L	M	H	DF	Score	PLM Result ND	Tr	<1	DF
6	original	26	4	0	0	0.13	0.13	--	--	--	--	--	--	--	--	--	--	--
	1	30	0	0	0	0	0.00	ND	30	0	0	0	0	0.00	30	0	0	0
	2	30	0	0	0	0	0.00	--	30	0	0	0	0	0.00	--			
	3	30	0	0	0	0	0.00	--	30	0	0	0	0	0.00	--			
	all (1-3)	90	0	0	0	0	0.00		90	0	0	0	0	0.00	30	0	0	0
7	original	21	8	1	0	0.3	0.37	--	--	--	--	--	--	--	--	--	--	--
	1	30	0	0	0	0	0.00	ND	30	0	0	0	0	0.00	30	0	0	0
	2	30	0	0	0	0	0.00	ND	30	0	0	0	0	0.00	16	0	0	0
	3	30	0	0	0	0	0.00	--	30	0	0	0	0	0.00	--			
	all (1-3)	90	0	0	0	0	0.00		90	0	0	0	0	0.00	46	0	0	0
8	original	6	20	3	1	0.8	1.30	--	--	--	--	--	--	--	--	--	--	--
	1	30	0	0	0	0	0.00	Tr	29	0	1	0	0.03	0.10	22	8	0	0.27
	2	30	0	0	0	0	0.00	ND	29	1	0	0	0.03	0.03	30	0	0	0
	3	28	1	1	0	0.07	0.13	ND	23	4	3	0	0.23	0.43	28	1	1	####
	all (1-3)	88	1	1	0	0.02	0.04		81	5	4	0	0.1	0.19	80	9	1	0.1

Original visible vermiculite results provided in the Outdoor Worker ABS SAP (USEPA 2008b; Table 3-1).

-- = no PLM-VE analysis was performed

TABLE 7-8
Outdoor Worker Exposure Point Concentrations and Risk Calculations for Exposures During Soil Disturbances

Panel A: CTE

	EPC	ET	EF	a	d	TWF	$IUR_{a,d}$	
ABS Area	PCME LA f/cc	hrs/day	days/yr	yrs	yrs	--	$(PCM\ f/cc)^{-1}$	Risk
1	2.0E-03	4	131	20	10	0.060	0.039	5E-06
2	2.3E-03	4	131	20	10	0.060	0.039	5E-06
3	6.3E-03	4	131	20	10	0.060	0.039	1E-05
4	< 4.3E-03	4	131	20	10	0.060	0.039	< 1E-05
5	1.4E-02	4	131	20	10	0.060	0.039	3E-05
6	2.5E-03	4	131	20	10	0.060	0.039	6E-06
7	1.3E-03	4	131	20	10	0.060	0.039	3E-06
8	3.1E-03	4	131	20	10	0.060	0.039	7E-06
Average	3.9E-03	4	131	20	10	0.060	0.039	< 9E-06

Panel B: RME

	EPC	ET	EF	a	d	TWF	$IUR_{a,d}$	
ABS Area	PCME LA f/cc	hrs/day	days/yr	yrs	yrs	--	$(PCM\ f/cc)^{-1}$	Risk
1	2.0E-03	4	135	20	25	0.062	0.069	8E-06
2	2.3E-03	4	135	20	25	0.062	0.069	1E-05
3	6.3E-03	4	135	20	25	0.062	0.069	3E-05
4	< 4.3E-03	4	135	20	25	0.062	0.069	< 2E-05
5	1.4E-02	4	135	20	25	0.062	0.069	6E-05
6	2.5E-03	4	135	20	25	0.062	0.069	1E-05
7	1.3E-03	4	135	20	25	0.062	0.069	5E-06
8	3.1E-03	4	135	20	25	0.062	0.069	1E-05
Average	3.9E-03	4	135	20	25	0.062	0.069	< 2E-05

Table 7-9
Outdoor Worker Exposure Point Concentrations and Risk Calculations for Exposures During Waste Bark Pile Disturbances

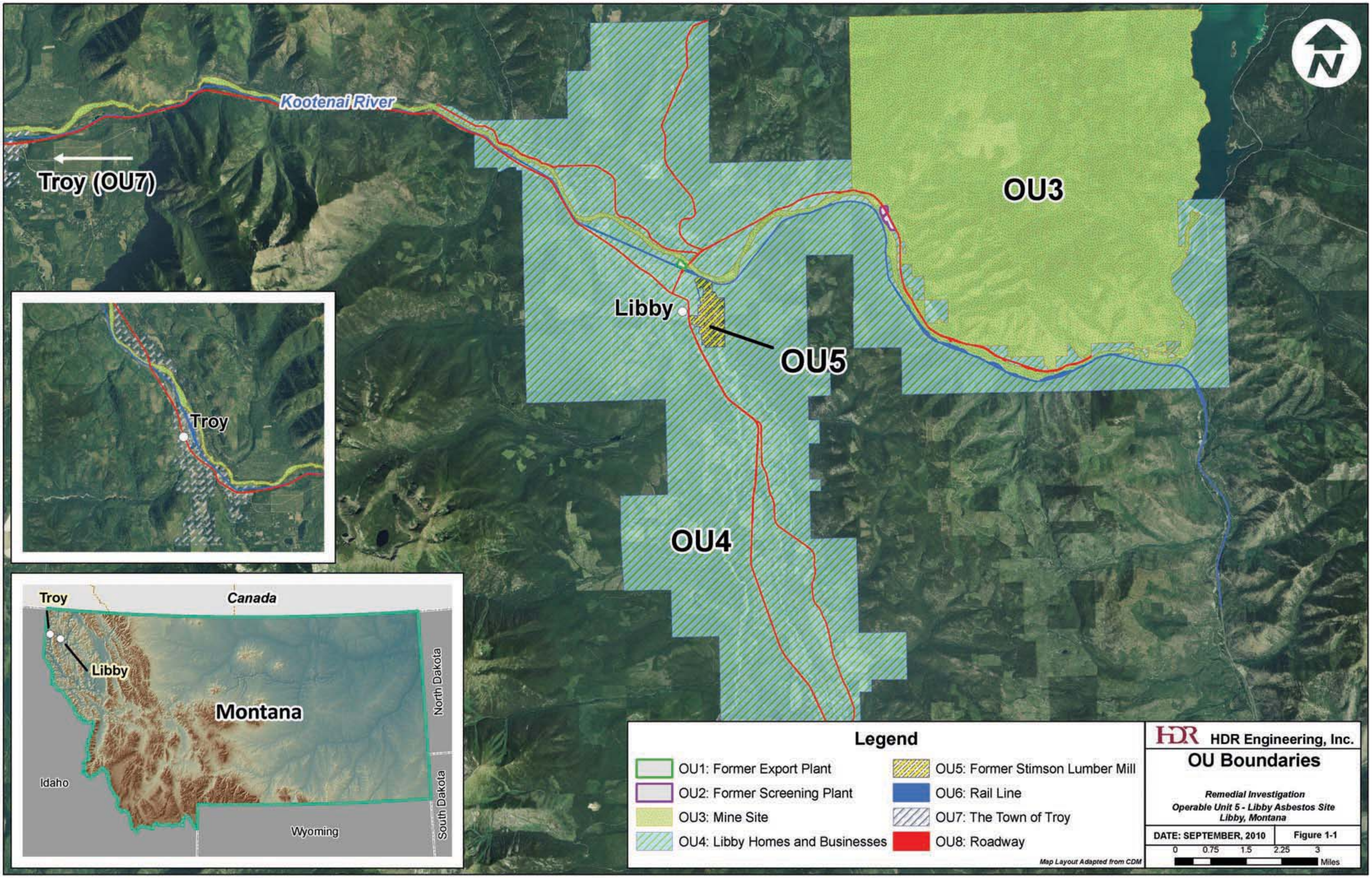
Panel A: CTE

EPC PCME f/cc	ET hrs/day	EF days/yr	a yrs	d yrs	TWF --	$IUR_{a,d}$ $(PCM\ f/cc)^{-1}$	Risk
< 0.0012	4	131	20	10	0.060	0.04	< 3E-06

Panel B: RME

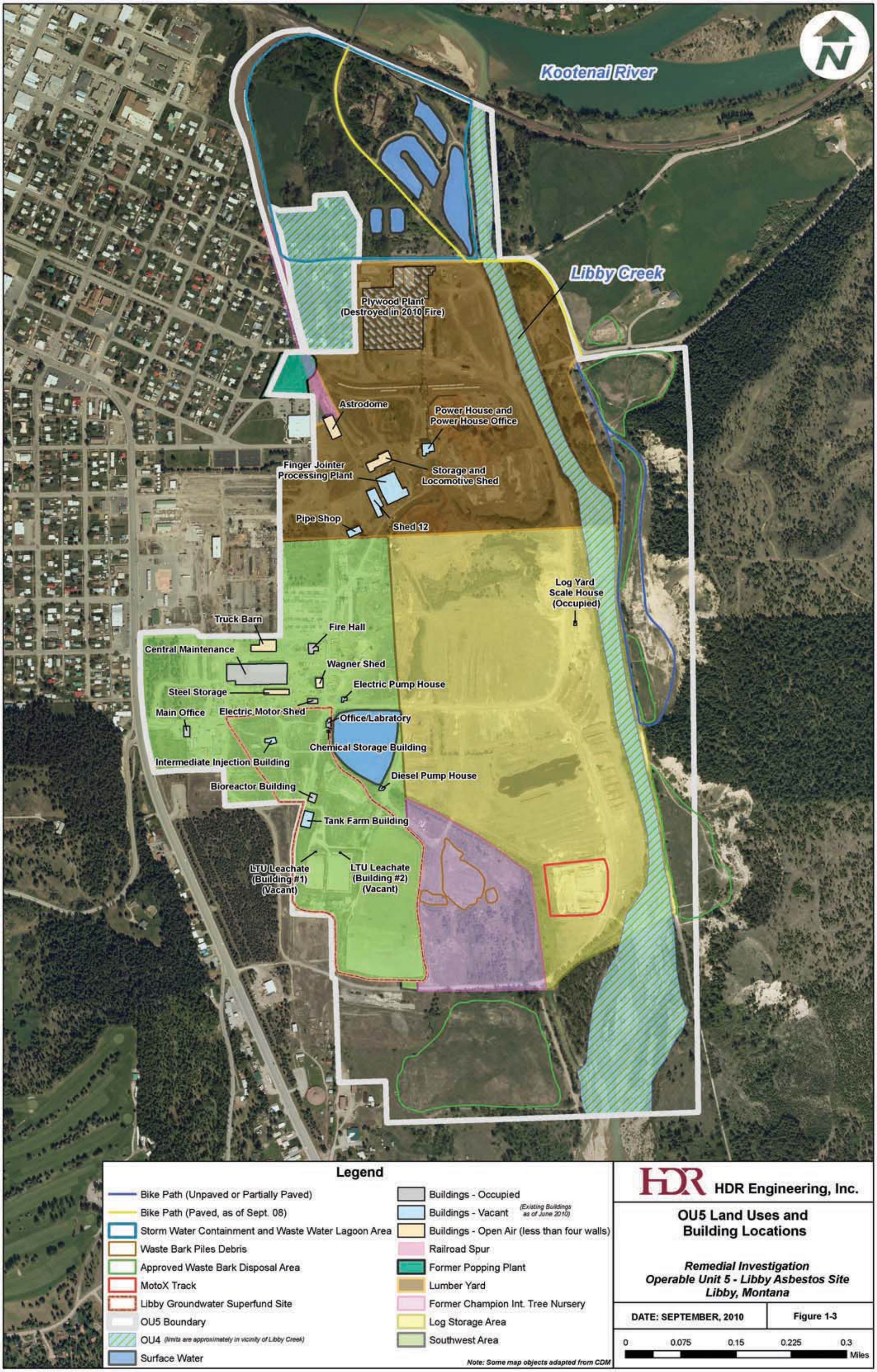
EPC PCME f/cc	ET hrs/day	EF days/yr	a yrs	d yrs	TWF --	$IUR_{a,d}$ $(PCM\ f/cc)^{-1}$	Risk
< 0.0012	4	135	20	25	0.062	0.07	< 5E-06

Figures

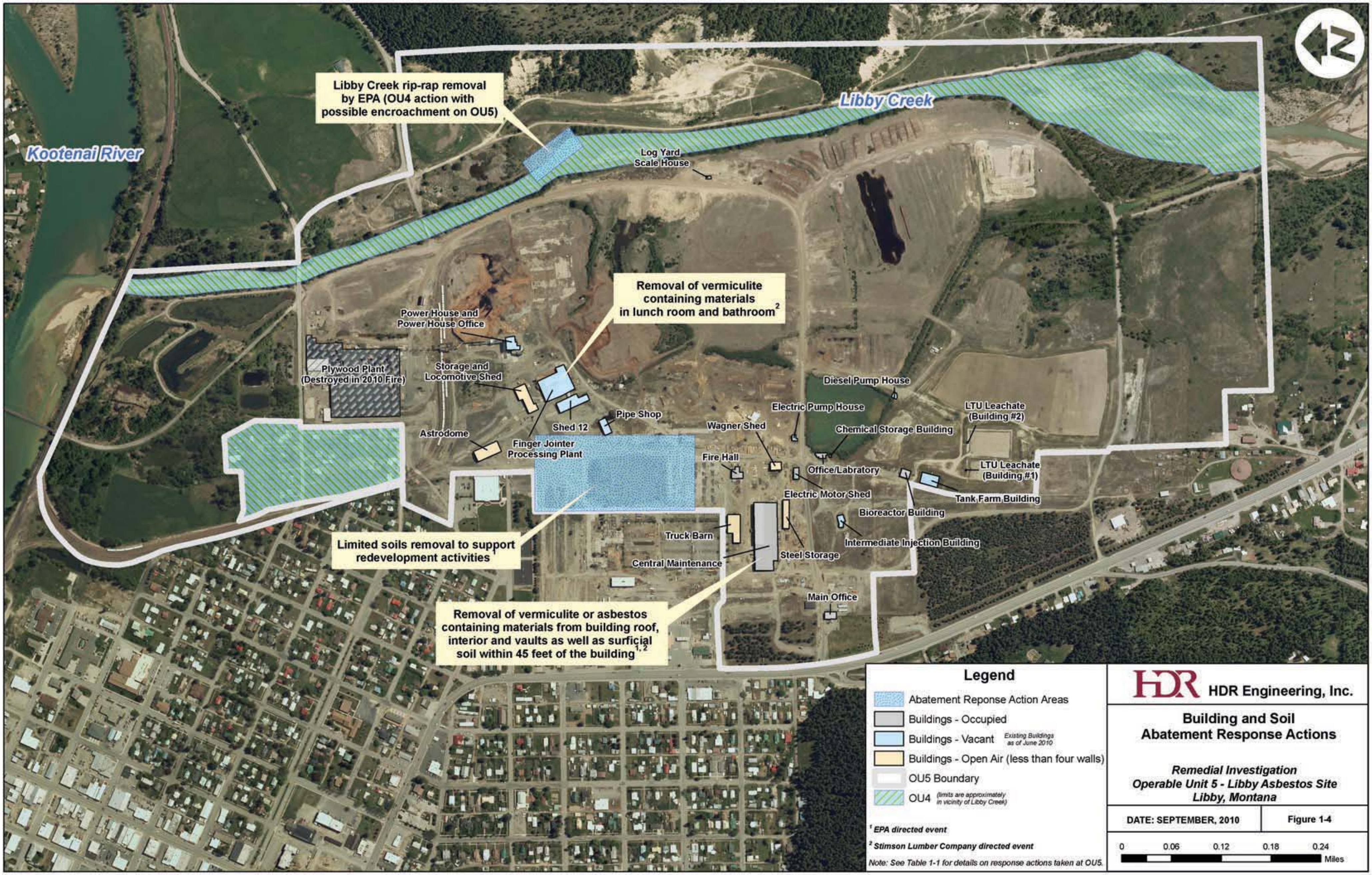


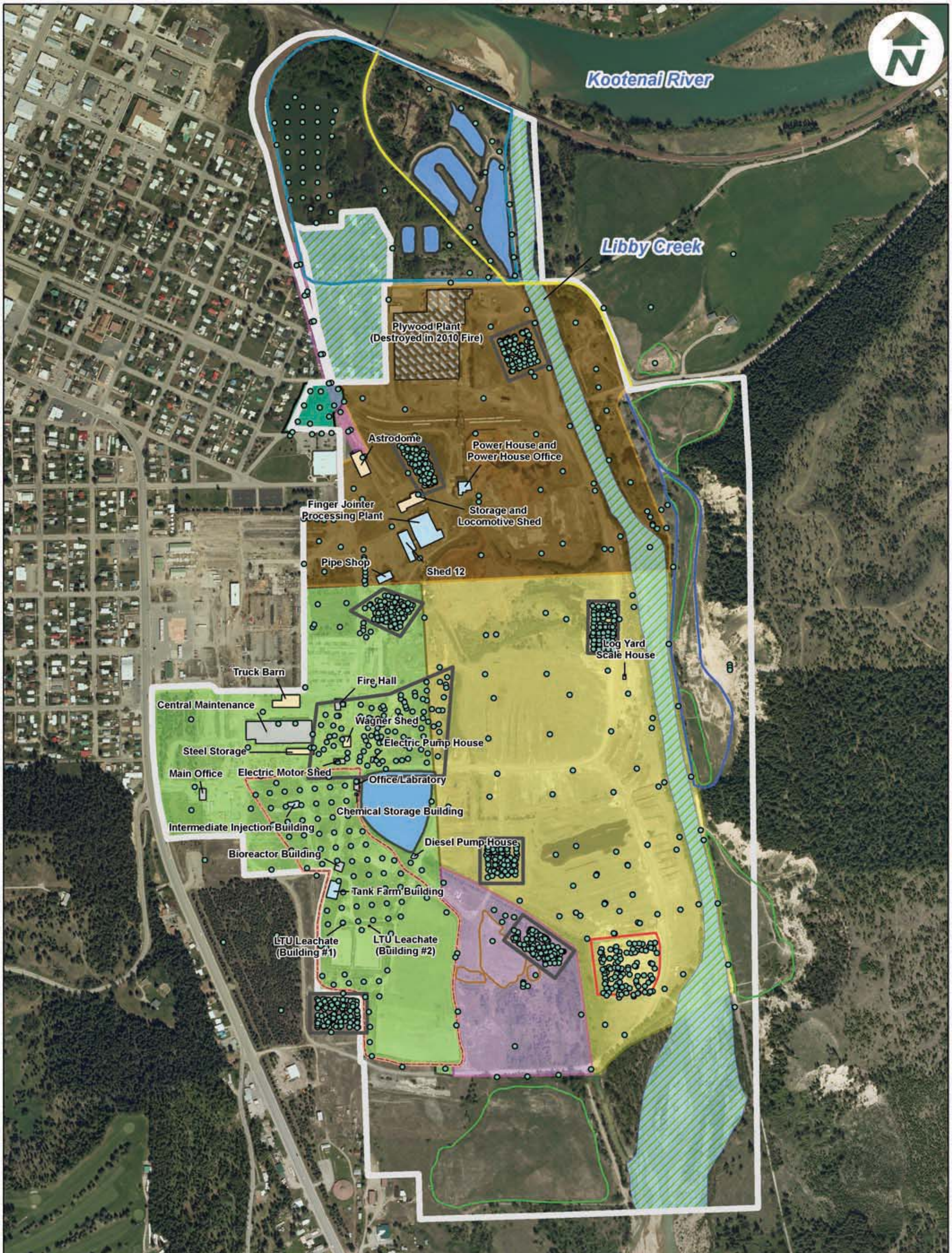
Kootenai River
Troy (OU7)
OU3
Libby
OU5
OU4
Troy
Troy
Canada
Libby
Montana
North Dakota
Idaho
South Dakota
Wyoming
Legend
OU1: Former Export Plant
OU2: Former Screening Plant
OU3: Mine Site
OU4: Libby Homes and Businesses
OU5: Former Stimson Lumber Mill
OU6: Rail Line
OU7: The Town of Troy
OU8: Roadway
Map Layout Adapted from CDM
HDR Engineering, Inc.
OU Boundaries
Remedial Investigation
Operable Unit 5 - Libby Asbestos Site
Libby, Montana
DATE: SEPTEMBER, 2010
Figure 1-1
0 0.75 1.5 2.25 3
Miles


37
Kootenai River
N
OU4
City of Libby
Libby Creek
OU5
Groundwater Superfund
Site
2
HDR Engineering, Inc.
Libby Groundwater Superfund Site
Remedial Investigation
Operable Unit 5 - Libby Asbestos Site
Libby, Montana
DATE: SEPTEMBER, 2010
Figure 1-2
0 0.075 0.15 0.225 0.3
Miles



Kootenai River
N
Libby Creek
Plywood Plant (Destroyed in 2010 Fire)
Astrodome
Power House and Power House Office
Finger Jointer Processing Plant
Storage and Locomotive Shed
Pipe Shop
Shed 12
Log Yard Scale House (Occupied)
Truck Barn
Fire Hall
Central Maintenance
Wagner Shed
Electric Pump House
Steel Storage
Main Office
Electric Motor Shed
Office/Labratory
Chemical Storage Building
Intermediate Injection Building
Diesel Pump House
Bioreactor Building
Tank Farm Building
LTU Leachate (Building #1) (Vacant)
LTU Leachate (Building #2) (Vacant)
Legend
Bike Path (Unpaved or Partially Paved)
Bike Path (Paved, as of Sept. 08)
Storm Water Containment and Waste Water Lagoon Area
Waste Bark Piles Debris
Approved Waste Bark Disposal Area
MotoX Track
Libby Groundwater Superfund Site
OU5 Boundary
OU4 (limits are approximately in vicinity of Libby Creek)
Surface Water
Buildings - Occupied
Buildings - Vacant (Existing Buildings as of June 2010)
Buildings - Open Air (less than four walls)
Railroad Spur
Former Popping Plant
Lumber Yard
Former Champion Int. Tree Nursery
Log Storage Area
Southwest Area
Note: Some map objects adapted from CDM
HDR Engineering, Inc.
OU5 Land Uses and Building Locations
Remedial Investigation
Operable Unit 5 - Libby Asbestos Site
Libby, Montana
DATE: SEPTEMBER, 2010
Figure 1-3
0 0.075 0.15 0.225 0.3
Miles


Libby Creek rip-rap removal by EPA (OU4 action with possible encroachment on OU5)
Libby Creek
Kootenai River
Log Yard Scale House
Removal of vermiculite containing materials in lunch room and bathroom[2]
Power House and Power House Office
Plywood Plant (Destroyed in 2010 Fire)
Storage and Locomotive Shed
Pipe Shop
Shed 12
Astrodome
Finger Jointer Processing Plant
Diesel Pump House
Electric Pump House
Wagner Shed
Chemical Storage Building
LTU Leachate (Building #2)
LTU Leachate (Building #1)
Fire Hall
Office/Labratory
Tank Farm Building
Electric Motor Shed
Bioreactor Building
Intermediate Injection Building
Truck Barn
Steel Storage
Central Maintenance
Main Office
Limited soils removal to support redevelopment activities[1]
Removal of vermiculite or asbestos containing materials from building roof, interior and vaults as well as surficial soil within 45 feet of the building[1, 2]
Legend
Abatement Reponse Action Areas
Buildings - Occupied
Buildings - Vacant
Existing Buildings as of June 2010
Buildings - Open Air (less than four walls)
OU5 Boundary
OU4
(limits are approximately in vicinity of Libby Creek)
[1] EPA directed event
[2] Stimson Lumber Company directed event
Note: See Table 1-1 for details on response actions taken at OU5.
HDR Engineering, Inc.
Building and Soil Abatement Response Actions
Remedial Investigation
Operable Unit 5 - Libby Asbestos Site
Libby, Montana
DATE: SEPTEMBER, 2010
Figure 1-4
0
0.06
0.12
0.18
0.24
Miles



Legend

- Surface Soil Sampling Locations
- Bike Path (Unpaved or Partially Paved)
- Bike Path (Paved, as of Sept. 08)
- Storm Water Containment and Waste Water Lagoon Area
- Waste Bark Piles Debris
- Approved Waste Bark Disposal Area
- MotoX Track
- Libby Groundwater Superfund Site
- Worker ABS Areas
- OU5 Boundary
- OU4 (limits are approximately in vicinity of Libby Creek)
- Surface Water
- Buildings - Occupied
- Buildings - Vacant (Existing Buildings as of June 2010)
- Buildings - Open Air (less than four walls)
- Railroad Spur
- Former Popping Plant
- Lumber Yard
- Former Champion Int. Tree Nursery
- Log Storage Area
- Southwest Area

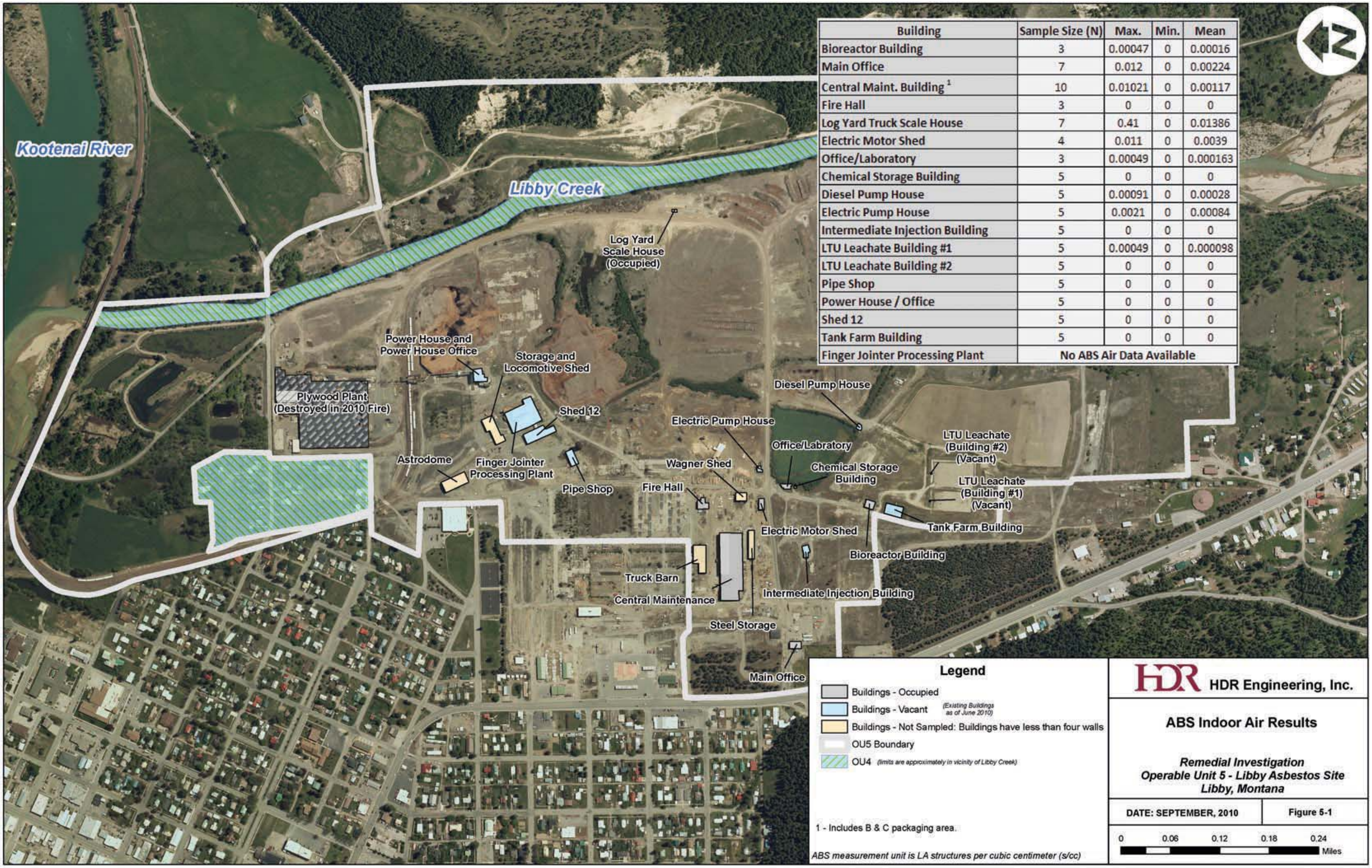
HDR Engineering, Inc.

Surface Soil Sampling Locations

Remedial Investigation
Operable Unit 5 - Libby Asbestos Site
Libby, Montana

DATE: SEPTEMBER, 2010	Figure 3-1

0 0.075 0.15 0.225 0.3 Miles



Building	Sample Size (N)	Max.	Min.	Mean
Bioreactor Building	3	0.00047	0	0.00016
Main Office	7	0.012	0	0.00224
Central Maint. Building [1]	10	0.01021	0	0.00117
Fire Hall	3	0	0	0
Log Yard Truck Scale House	7	0.41	0	0.01386
Electric Motor Shed	4	0.011	0	0.0039
Office/Laboratory	3	0.00049	0	0.000163
Chemical Storage Building	5	0	0	0
Diesel Pump House	5	0.00091	0	0.00028
Electric Pump House	5	0.0021	0	0.00084
Intermediate Injection Building	5	0	0	0
LTU Leachate Building #1	5	0.00049	0	0.000098
LTU Leachate Building #2	5	0	0	0
Pipe Shop	5	0	0	0
Power House / Office	5	0	0	0
Shed 12	5	0	0	0
Tank Farm Building	5	0	0	0
Finger Jointer Processing Plant	No ABS Air Data Available			

1 - Includes B & C packaging area.

ABS measurement unit is LA structures per cubic centimeter (s/cc)

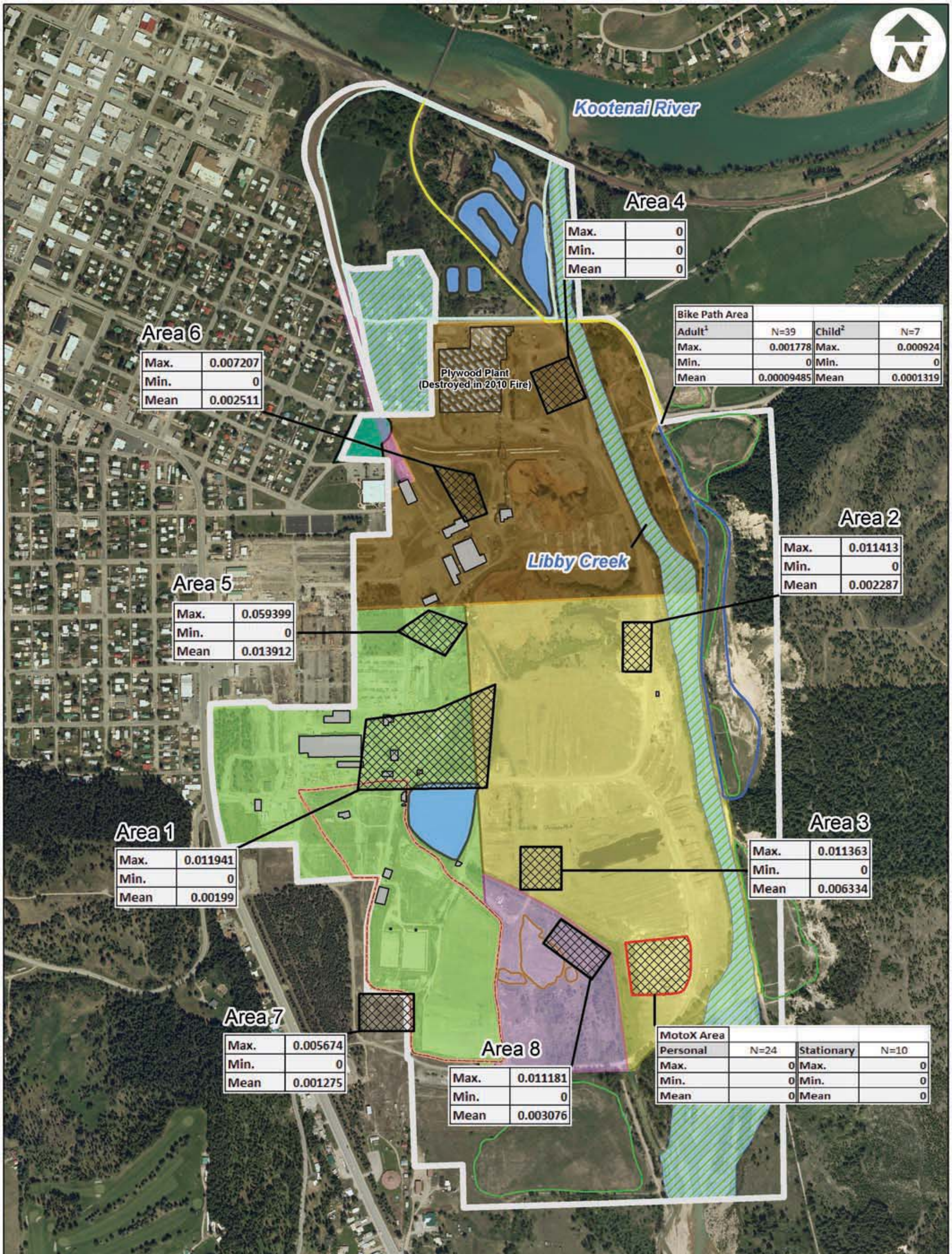
HDR Engineering, Inc.

ABS Indoor Air Results

Remedial Investigation
Operable Unit 5 - Libby Asbestos Site
Libby, Montana

DATE: SEPTEMBER, 2010

Figure 5-1



ABS Outdoor Air Testing Sites*

- Bike Path (Unpaved or Partially Paved)
- Bike Path (Paved, as of Sept. 08)
- Worker ABS Areas **(N = 6)**
- MotoX Track

- Storm Water Containment and Waste Water Lagoon Area
- Waste Bark Piles Debris
- Approved Waste Bark Disposal Area
- Libby Groundwater Superfund Site
- OU5 Boundary
- OU4 *(limits are approximately in vicinity of Libby Creek)*
- Buildings *(Existing Buildings as of June 2010)*
- Surface Water
- Railroad Spur
- Former Popping Plant
- Lumber Yard
- Former Champion Int. Tree Nursery
- Log Storage Area
- Southwest Area

Note:* * *ABS Measurement Unit: LA structures per cubic centimeter (s/cc)
[1] "Adult" personal air samples were collected while riding a bicycle on both the paved and unpaved portions of the bicycle path.
[2] "Child" personal air samples were collected via an air monitor placed in a trailer attachment to a bicycle. "Child" personal air samples were collected only on the paved portion of the bike path.

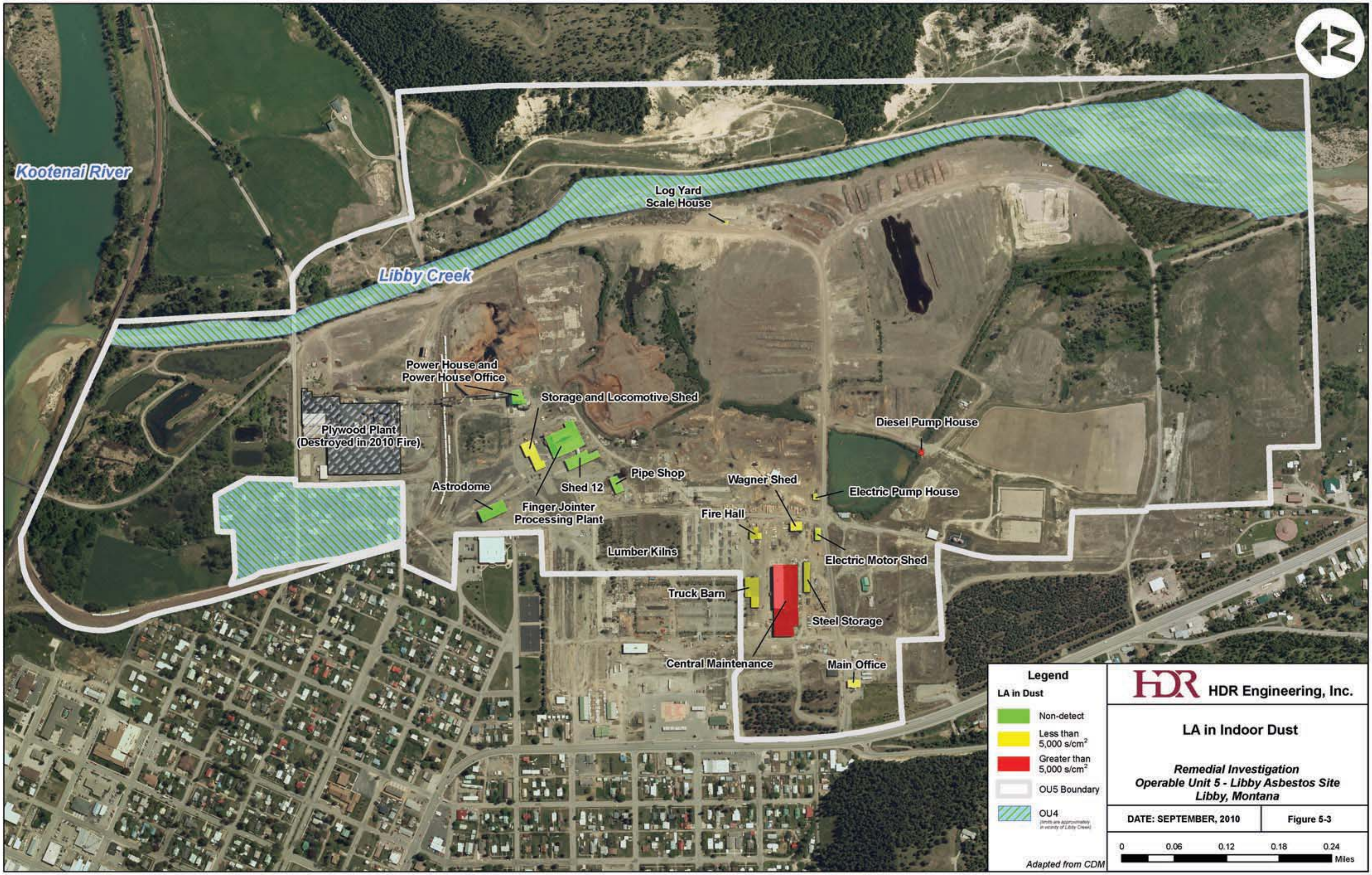
HDR Engineering, Inc.

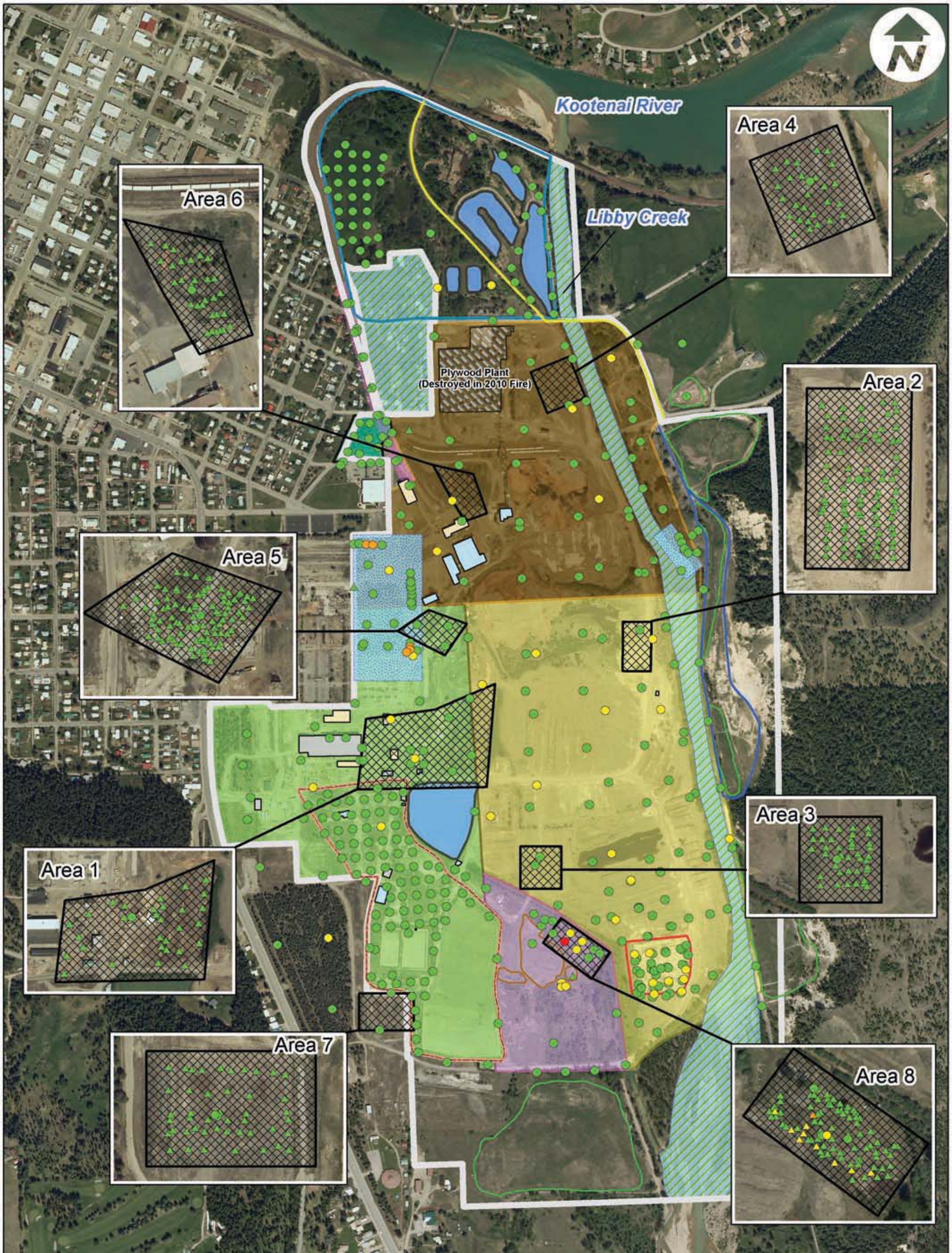
ABS Outdoor Air Results

Remedial Investigation
Operable Unit 5 - Libby Asbestos Site
Libby, Montana

DATE: SEPTEMBER, 2010 | **Figure 5-2**

0 0.08 0.16 0.24 0.32 Miles


Kootenai River
Libby Creek
Log Yard Scale House
Power House and Power House Office
Storage and Locomotive Shed
Plywood Plant (Destroyed in 2010 Fire)
Diesel Pump House
Pipe Shop
Shed 12
Astrodome
Finger Jointer Processing Plant
Wagner Shed
Electric Pump House
Fire Hall
Lumber Kilns
Electric Motor Shed
Truck Barn
Steel Storage
Central Maintenance
Main Office
Legend
LA in Dust
Non-detect
Less than 5,000 s/cm^2
Greater than 5,000 s/cm^2
OU5 Boundary
OU4
Adapted from CDM
HDR Engineering, Inc.
LA in Indoor Dust
Remedial Investigation
Operable Unit 5 - Libby Asbestos Site
Libby, Montana
DATE: SEPTEMBER, 2010
Figure 5-3
0 0.06 0.12 0.18 0.24
Miles



LA Results

Grab Samples

- < 1%
- Trace
- Non-Detect

Composite Samples

- >= 1%
- < 1%
- Trace
- Non-Detect

- Bike Path (Unpaved or Partially Paved)
- Bike Path (Paved, as of Sept. 08)
- Storm Water Containment and Waste Water Lagoon Area
- Waste Bark Piles Debris
- Approved Waste Bark Disposal Area
- MotoX Track
- Libby Groundwater Superfund Site
- Worker ABS Areas
- OU5 Boundary
- OU4 (limits are approximately in vicinity of Libby Creek)
- Abatement Reponse Action Areas[1]

- Buildings - Occupied
- Buildings - Vacant (Existing Buildings as of June 2010)
- Buildings - Open Air (less than four walls)
- Surface Water
- Railroad Spur
- Former Popping Plant
- Lumber Yard
- Former Champion Int. Tree Nursery
- Log Storage Area
- Southwest Area

[1] *Results shown on Figure reflect testing done before abatement actions. See Figure 1-4 & Table 1-1 for details on response actions taken at OU5.*

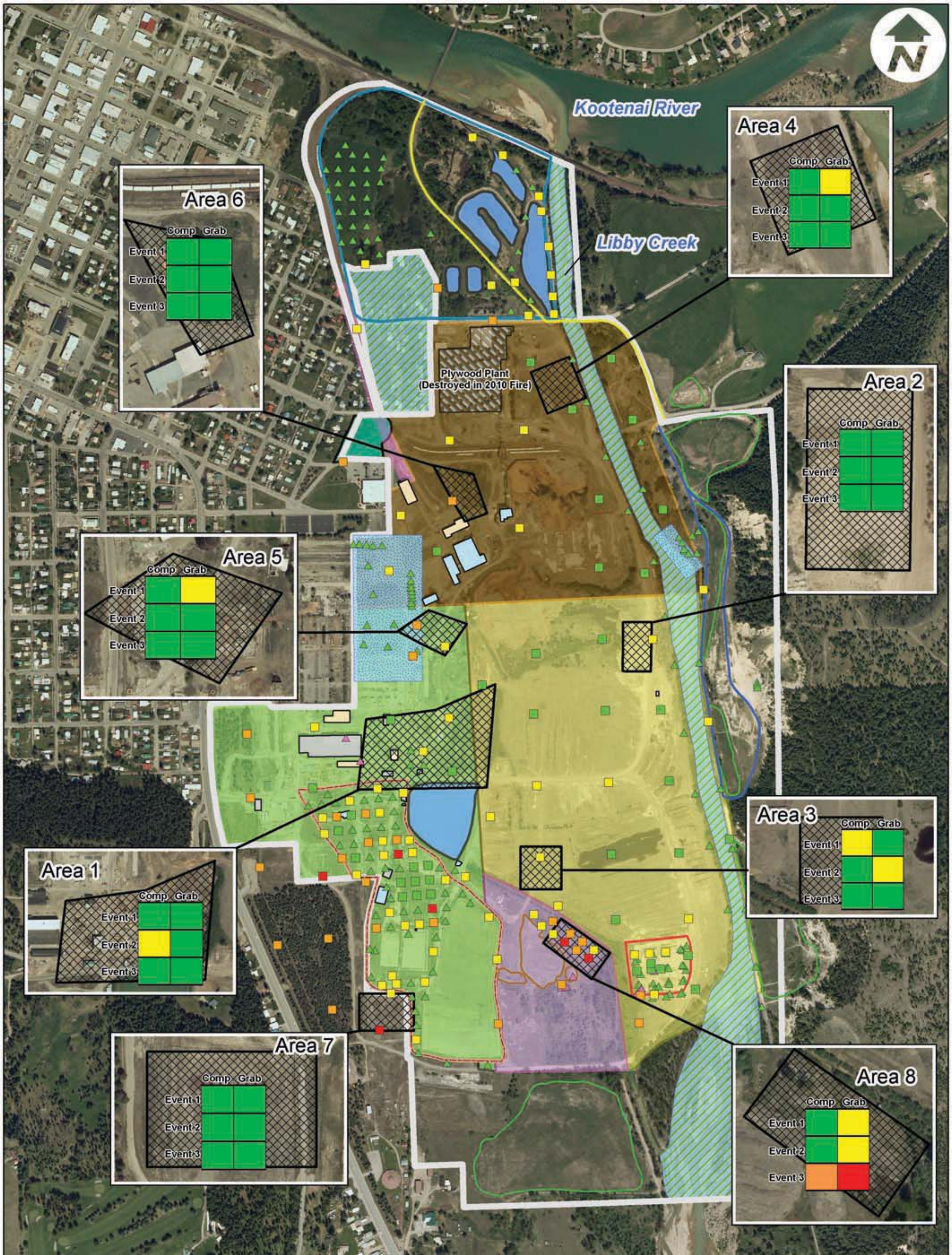
HDR Engineering, Inc.

LA in Surface Soil - PLM Results

Remedial Investigation
Operable Unit 5 - Libby Asbestos Site
Libby, Montana

DATE: SEPTEMBER, 2010	Figure 5-4

0 0.08 0.16 0.24 0.32 Miles



Visible Vermiculite Results

Composite Score

- > 0.3 - 0.5
- > 0.1 - 0.3
- <= 0.1
- 0 (Non-Detect)

Qualitative Status (Grab & Comp.)

- VIS +
- VIS -

ABS Score

Note: The ABS results matrix presents the visible vermiculite scores for the three 30-point composite samples and the three sets of 30 grab samples (see Section 3.2.2 for discussion of visible vermiculite scoring).

- Bike Path (Unpaved or Partially Paved)
- Bike Path (Paved, as of Sept. 08)
- Storm Water Containment and Waste Water Lagoon Area
- Waste Bark Piles Debris
- Approved Waste Bark Disposal Area
- MotoX Track
- Worker ABS Areas
- OU5 Boundary
- OU4 (limits are approximately in vicinity of Libby Creek)
- Abatement Reponse Action Areas[1]
- Buildings - Occupied
- Buildings - Vacant (Existing Buildings as of June 2010)
- Buildings - Open Air (less than four walls)
- Surface Water
- Libby Groundwater Superfund Site
- Railroad Spur
- Former Popping Plant
- Lumber Yard
- Former Champion Int. Tree Nursery
- Log Storage Area
- Southwest Area

[1] *Results shown on Figure reflect testing done before abatement actions. See Figure 1-4 & Table 1-1 for details on response actions taken at OU5.*

HDR Engineering, Inc.

Visible Vermiculite in Surface Soils

Remedial Investigation
Operable Unit 5 - Libby Asbestos Site
Libby, Montana

DATE: SEPTEMBER, 2010

Figure 5-5

0 0.08 0.16 0.24 0.32 Miles

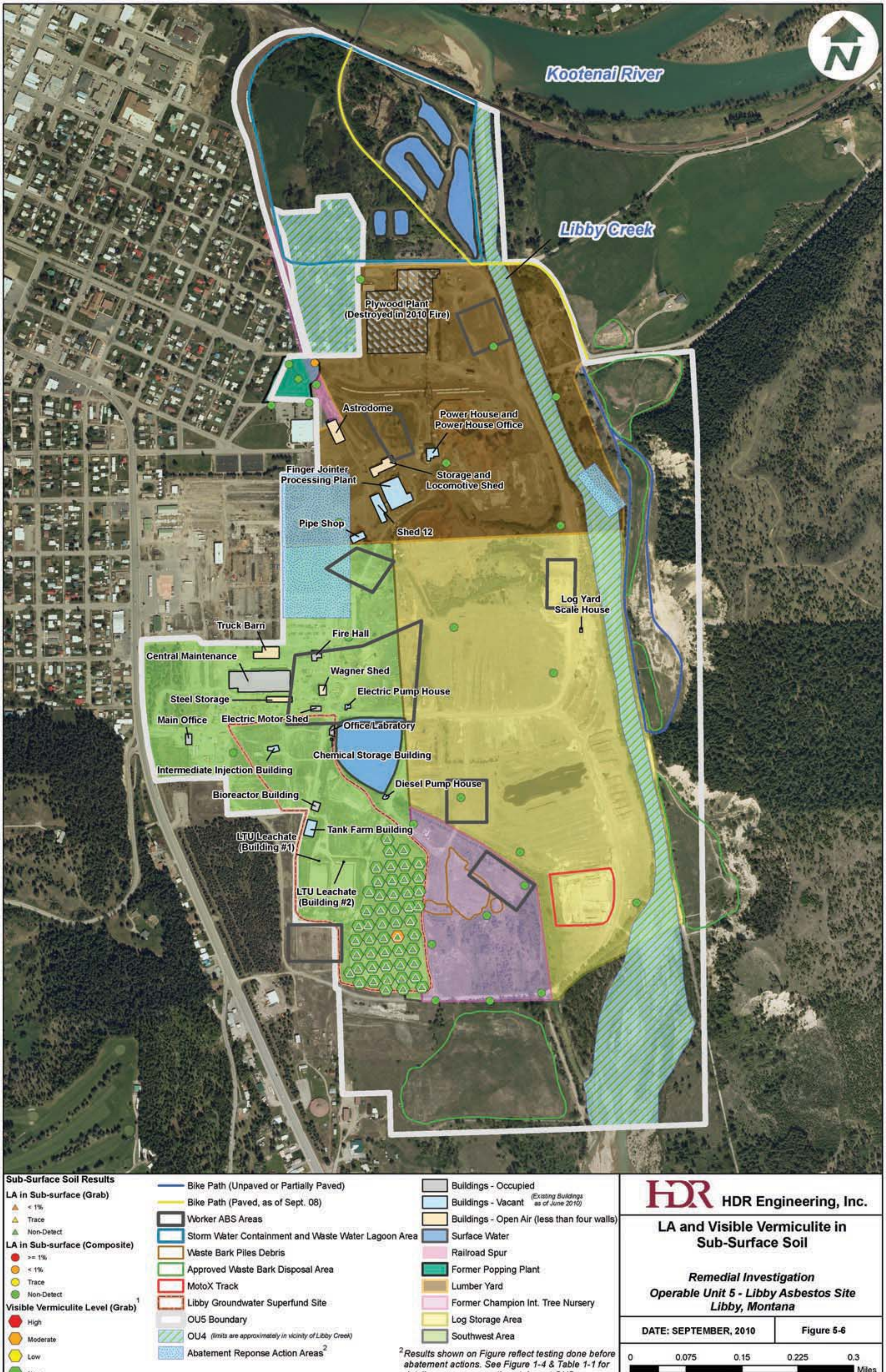
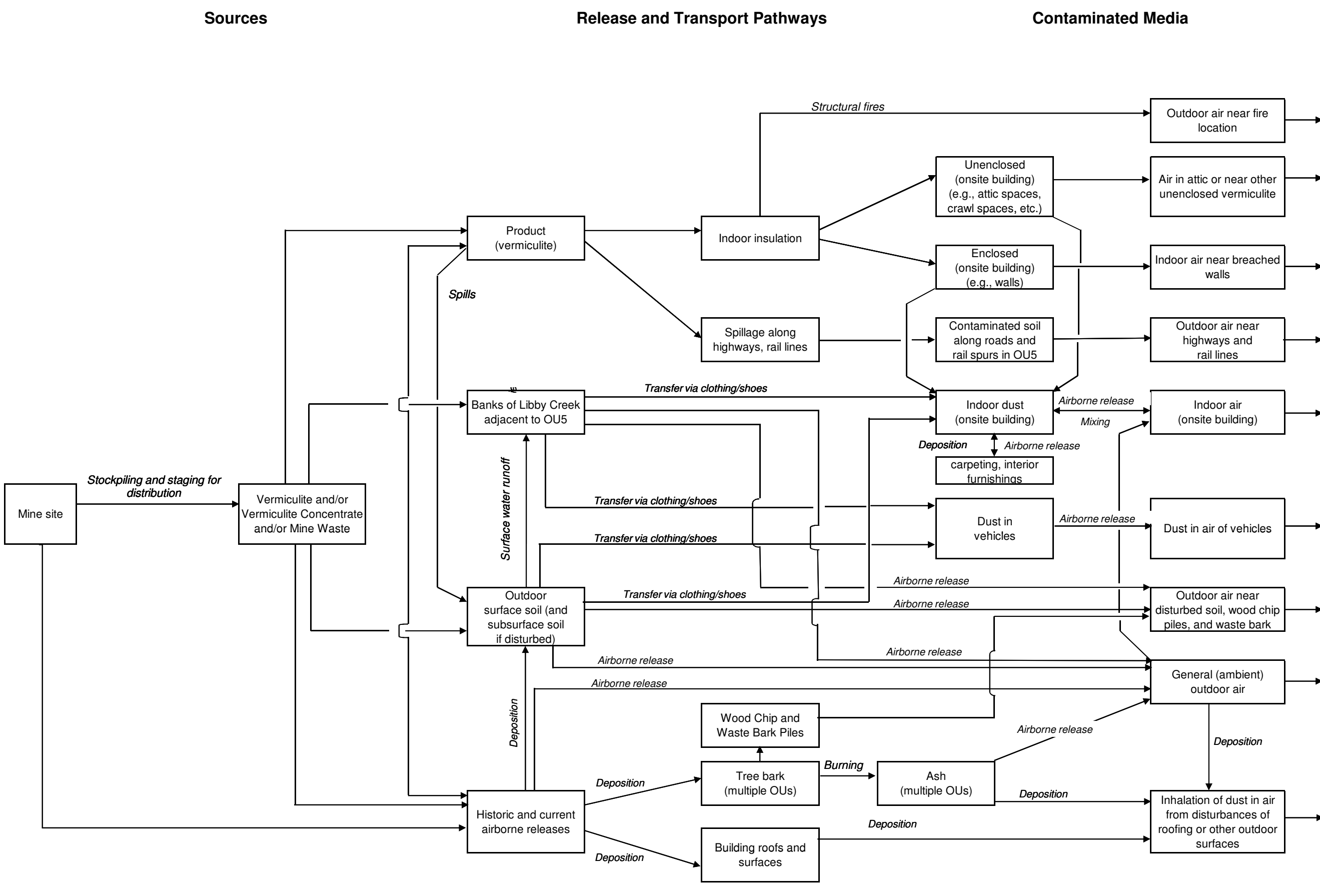

Kootenai River
Libby Creek
Plywood Plant (Destroyed in 2010 Fire)
Astrodome
Power House and Power House Office
Finger Jointer Processing Plant
Storage and Locomotive Shed
Pipe Shop
Shed 12
Log Yard Scale House
Truck Barn
Fire Hall
Central Maintenance
Wagner Shed
Electric Pump House
Steel Storage
Main Office
Electric Motor Shed
Office Labratory
Chemical Storage Building
Intermediate Injection Building
Diesel Pump House
Bioreactor Building
Tank Farm Building
LTU Leachate (Building #1)
LTU Leachate (Building #2)
Sub-Surface Soil Results
LA in Sub-surface (Grab)
< 1%
Trace
Non-Detect
LA in Sub-surface (Composite)
>= 1%
< 1%
Trace
Non-Detect
Visible Vermiculite Level (Grab)[1]
High
Moderate
Low
None
[1] See Section 3.2.2.
Bike Path (Unpaved or Partially Paved)
Bike Path (Paved, as of Sept. 08)
Worker ABS Areas
Storm Water Containment and Waste Water Lagoon Area
Waste Bark Piles Debris
Approved Waste Bark Disposal Area
MotoX Track
Libby Groundwater Superfund Site
OU5 Boundary
OU4 (limits are approximately in vicinity of Libby Creek)
Abatement Reponse Action Areas[2]
Buildings - Occupied
Buildings - Vacant (Existing Buildings as of June 2010)
Buildings - Open Air (less than four walls)
Surface Water
Railroad Spur
Former Popping Plant
Lumber Yard
Former Champion Int. Tree Nursery
Log Storage Area
Southwest Area
[2] Results shown on Figure reflect testing done before abatement actions. See Figure 1-4 & Table 1-1 for details on response actions taken at OU5.
HDR Engineering, Inc.
LA and Visible Vermiculite in Sub-Surface Soil
Remedial Investigation
Operable Unit 5 - Libby Asbestos Site
Libby, Montana
DATE: SEPTEMBER, 2010
Figure 5-6
0
0.075
0.15
0.225
0.3
Miles

Figure 7-1

INITIAL CONCEPTUAL SITE MODEL FOR INHALATION EXPOSURES TO ASBESTOS

Libby Superfund Site -- Operable Unit 5 (Former Stimson Lumber Mill)



	Commercial Worker Current	Commercial Worker Future	Tradesperson Current	Tradesperson Future	Recreational Visitor Current	Recreational Visitor Future	Resident Future
Outdoor air near fire location	?	?	?	?	?	?	?
Air in attic or near other unenclosed vermiculite	●	●	●	●			
Indoor air near breached walls	●	●	●	●			
Outdoor air near highways and rail lines	●	●	●	●			
Indoor air (onsite building)	●	●	?	?			●
Dust in air of vehicles	?	?	?	?	?	?	?
Outdoor air near disturbed soil, wood chip piles, and waste bark	●	●	●	●	●	●	●
General (ambient) outdoor air	●	●	●	●	●	●	●
Inhalation of dust in air from disturbances of roofing or other outdoor surfaces	?	?	?	?			

KEY

●	Pathway is complete and exposure may be significant; quantitative evaluation is warranted
O	Pathway is complete but is believed to be minor in comparison to other pathways; qualitative evaluation is warranted
?	Pathway may be complete but magnitude of exposure is uncertain; further investigation may be necessary
	Pathway is incomplete or believed to be negligible; further evaluation is not warranted

Figure 7-2
SIMPLIFIED CONCEPTUAL SITE MODEL FOR INHALATION EXPOSURE TO ASBESTOS
Libby Superfund Site - Operable Unit 5 (Former Stimson Lumber Mill)

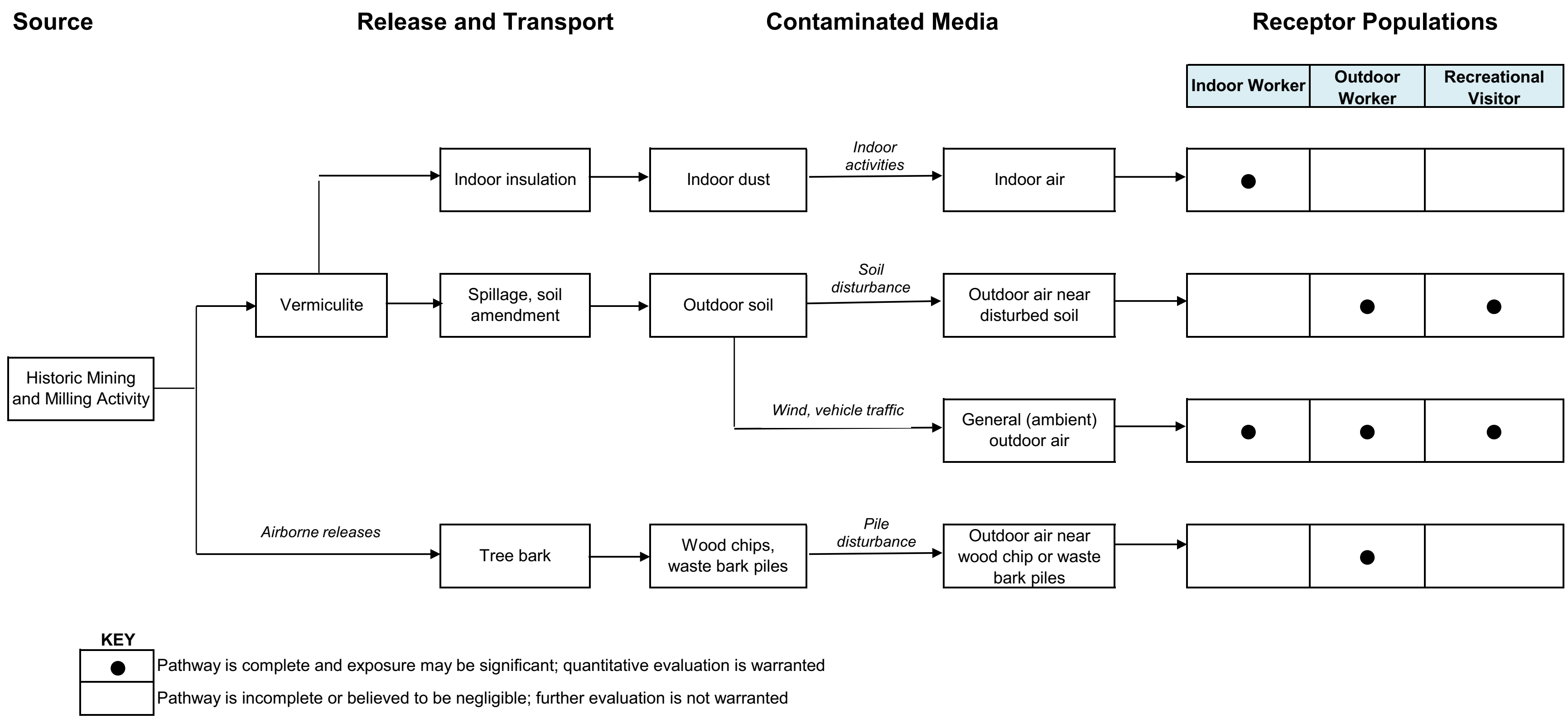
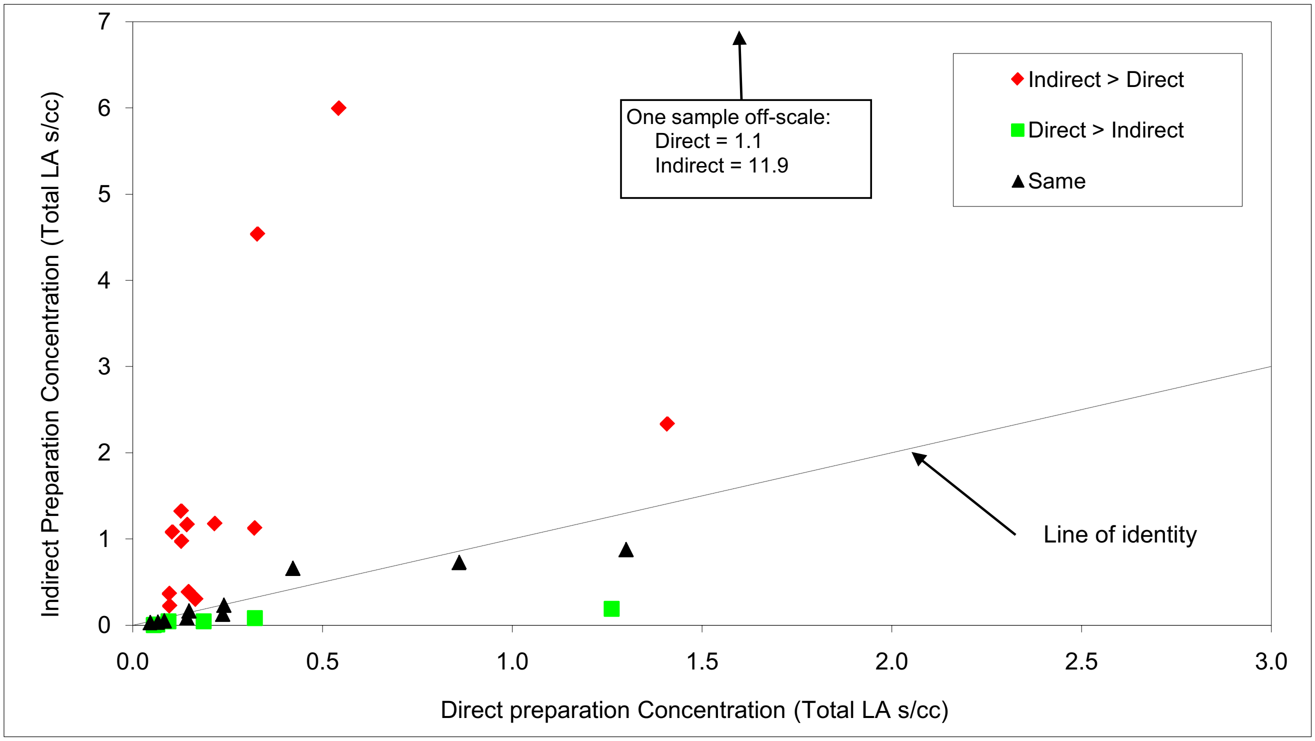


Figure 7-3
Comparison of Direct and Indirect TEM Results for 31 Air Samples from Libby

Panel A: Total LA



Panel B: PCME LA

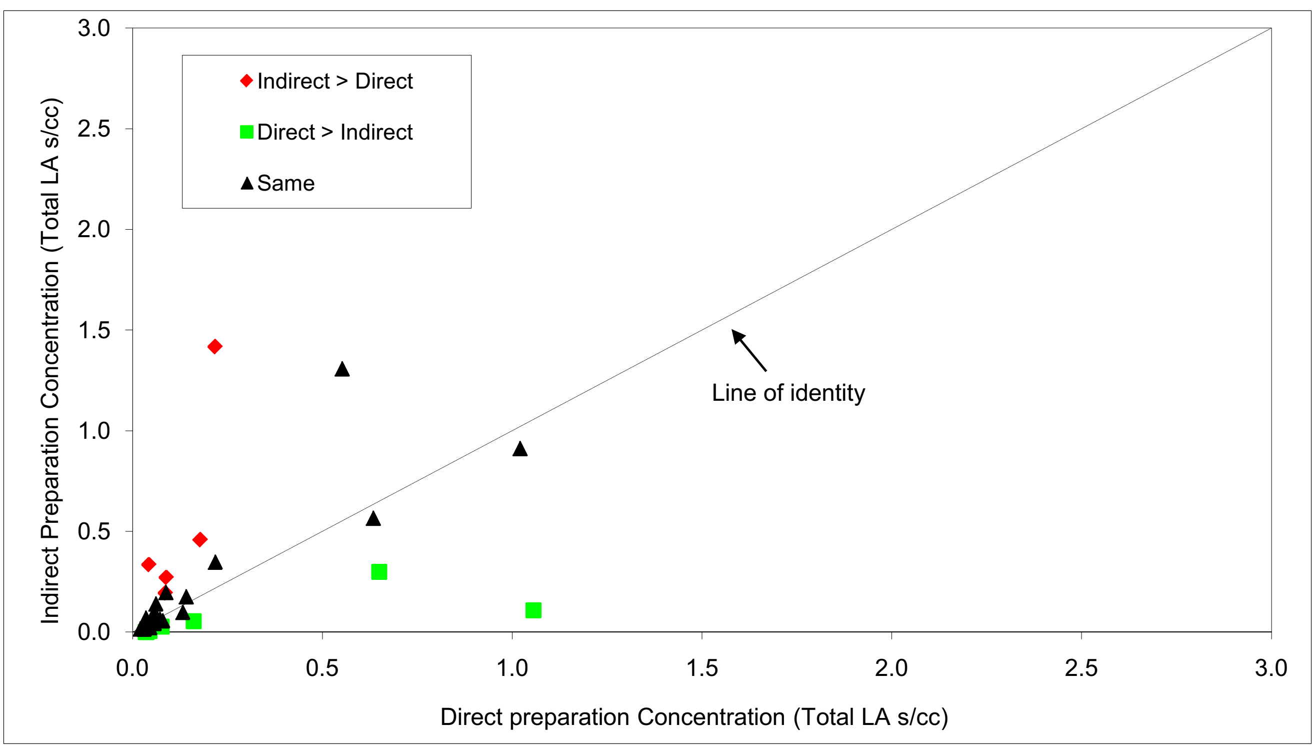
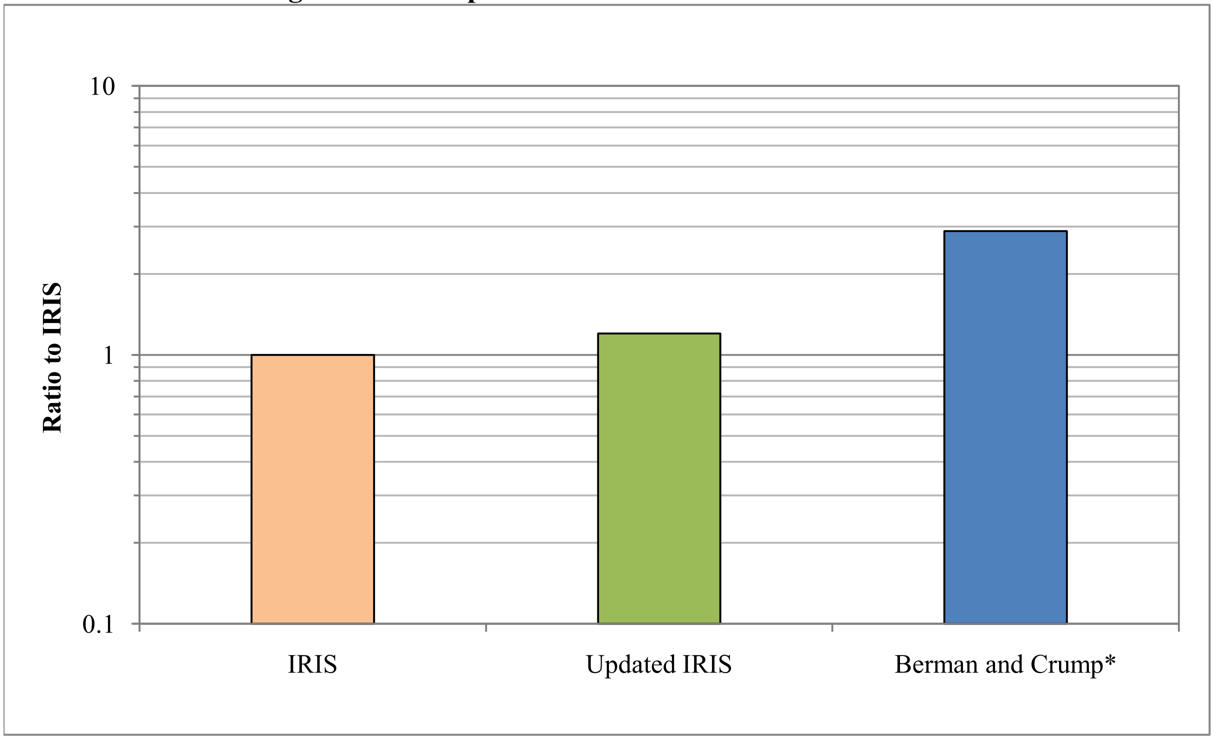


Figure 7-4. Comparison of Total Cancer Risk Estimates



*Based on an assumed ratio of 0.25 Berman-Crump protocol structures (length > 10 um) per PCME structure

Appendices

Appendix A
Response Action Reports

Appendix A1
OU5 Redevelopment Area
Investigation Summary

CDM

Memorandum

To: *Amishi Castelli, Volpe Center Task Order Manager*

From: *Thomas Cook, CHMM, CDM Field Investigation Manager*

Date: *May 12, 2009*

Subject: *Investigation Summary – OU5 Re-development Area*

Background

CDM Federal Programs Corporation (CDM) was tasked with performing investigation activities within a designated area on the former Stimson Lumber Company site, OU5, to support future re-development activities. The investigation consisted of collecting soil samples for Libby amphibole (LA) asbestos analysis, performing inspections for vermiculite, and delineating areas with LA contamination and/or vermiculite for subsequent removal activities.

Investigation Summary

All work was completed in accordance with the technical memorandum dated April 17, 2009 from Thomas Cook to Amishi Castelli, Subject: Soil Sampling and Visual Inspection – OU5 Re-development Area (CDM 2009). The investigation activities were performed April 20 through April 22, 2009. Prior to field activities, a field planning meeting was held with key members of the field sampling team to review the sampling plan and procedures. There were no deviations in sampling or inspections from the technical memorandum or associated documents.

Eight sampling zones were established, sampled, and inspected in accordance with the technical memorandum (Figure 1). Only soil/gravel areas within the identified zones were sampled and inspected. Areas covered with concrete or pavement were not included as part of this inspection. Figure 2 illustrates the detail of each sampling zone and location of vermiculite observed. Copies of logbook entries, field sample data sheets, and visual vermiculite estimation forms are included in Attachment A.

A total of nine soil samples (eight field samples and one field duplicate) were collected. In addition, vermiculite inspections were performed in each sampling zone. All soil samples were analyzed for LA by the polarized light microscopy-visual estimation method (SRC 2008). Analytical results for all samples were non-detect for LA (Attachment B). Low amounts of vermiculite were observed in zones six and seven. In zone six, vermiculite was observed concentrated within a specific area between the north road and concrete slab (Figure 2). Within zone seven, vermiculite was observed widespread throughout the entire zone. The following table summarizes the analytical and vermiculite inspection results for each sampling zone:

Zone	Sample Index ID	Analytical Result (Percent Libby Amphibole)	Number of Vermiculite Inspection Points by Zone			
			None	Low	Medium	High
1	SL-01760	Non-detect	30	0	0	0
2	SL-01761	Non-detect	30	0	0	0
2	SL-01768[1]	Non-detect	30	0	0	0
3	SL-01762	Non-detect	30	0	0	0
4	SL-01763	Non-detect	30	0	0	0
5	SL-01764	Non-detect	30	0	0	0
6	SL-01765	Non-detect	30	6[2]	0	0
7	SL-01766	Non-detect	30	10[3]	0	0
8	SL-01767	Non-detect	30	0	0	0

[1]sample SL-01768 is a field duplicate of SL-01761
[2]concentrated in specific area
[3]widespread throughout sample zone

Removal Activities

Areas requiring removal activities were identified based on results of this inspection and information gathered during previous investigations. In general, areas were identified for removal if vermiculite was observed and/or analytical results had detectable levels of LA. Figure 3 illustrates the areas requiring removal activities.

Prior to removal activities, a government representative will meet with the property owner to review the removal plan. During removal activities, only government-authorized personnel are allowed to access the areas being remediated.

All work at the property will be conducted in accordance with the Comprehensive Site Health and Safety Plan (CDM 2006) and the Response Action Work Plan, Revision 2 (CDM 2008a).

The following table summarizes the areas identified for removal and planned restoration activities.

Area	Rationale	Approximate Area (ft^2)	Excavation	Approximate Volume (yd^3)	Restoration
A	Vermiculite[1]	10,845	6 inches below surrounding grade	822	¾-inch minus crushed rock to grade
B	Vermiculite[2]	25,300	12 inches below grade	937	¾-inch minus crushed rock to grade
C	Vermiculite[2]	5,315	12 inches below grade	197	¾-inch minus crushed rock to grade

[1]observed during vermiculite inspection June 2008
[2]observed during vermiculite inspection April 2009
ft^2 – square feet
yd^3 – cubic yards

The total volume of material to remove is approximately 1,956 cubic cards. Area A, including mounded areas, will be excavated to 6 inches below surrounding grade. Areas B and C will be excavated to 12 inches below grade. Confirmation soil samples will be collected in accordance with the Response Action Sampling and Analysis Plan, Revision 1 (CDM 2008b). All areas will be restored with ¾-inch minus crushed rock (structural fill) to grade.

References

CDM. 2006. Comprehensive Site Health and Safety Plan, Revision 5. Libby Asbestos Project, Libby, Montana. December.

____. 2008a. Response Action Work Plan, Revision 2, Libby Asbestos Project, Libby, Montana. February.

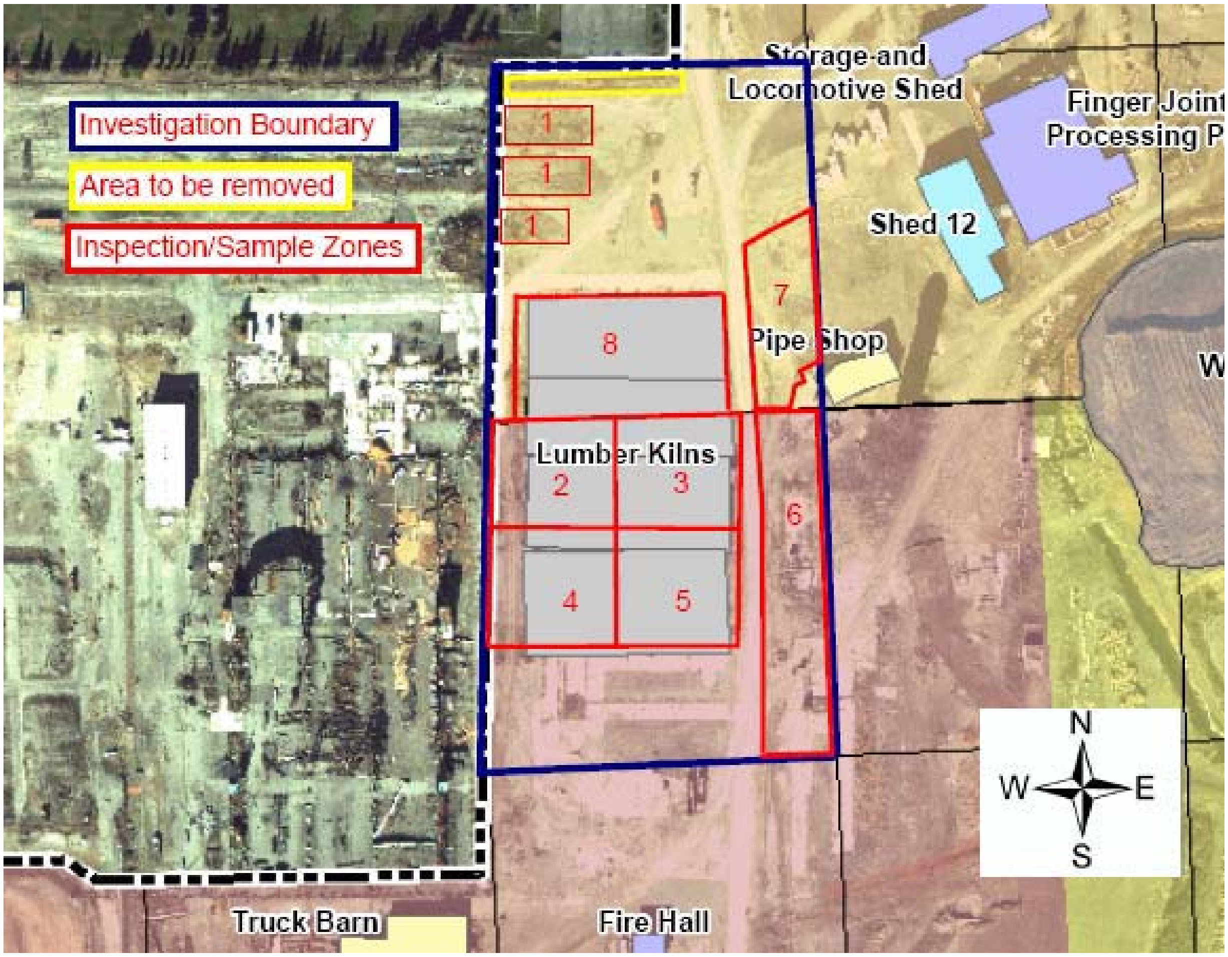
____. 2008b. Response Action Sampling and Analysis Plan, Revision 1, Libby Asbestos Project, Libby, Montana. April.

___. 2009. Technical Memorandum from Thomas Cook to Amishi Castelli, Subject: Soil Sampling and Visual Inspection – OU5 Re-development Area. April.

SRC. 2008. Analysis of Asbestos Fibers in Soil by Polarized Light Microscopy, SOP No. SRC-LIBBY-03, Revision 2. October.

cc: Julie Borgesi - Volpe Center, Cambridge
Courtney Zamora – Volpe Center, Libby
Dee Warren – CDM, Denver
Terry Crowell – CDM, Libby
Libby Project File – Denver

Figure 1



Investigation Boundary
Area to be removed
Inspection/Sample Zones
Storage and Locomotive Shed
Finger Joint Processing P
Shed 12
Pipe Shop
Lumber Kilns
1
1
1
2
3
4
5
6
7
8
N
W
E
S
Truck Barn
Fire Hall

CLIENT VOLPE
PROJECT LIBBY ASBESTOS
DETAIL 875 HWY 2 S - STIMSON
RE-INVESTIGATION OF AREAS AROUND GPS NODES SL-43, SL-45, SL-51, SL-52, SL-59 AND SL-60-015 REDEVELOPMENT
JOB NO.
DATE CHECKED
CHECKED BY
COMPUTED BY S. WILSON
DATE 4-22-09
PAGE NO.

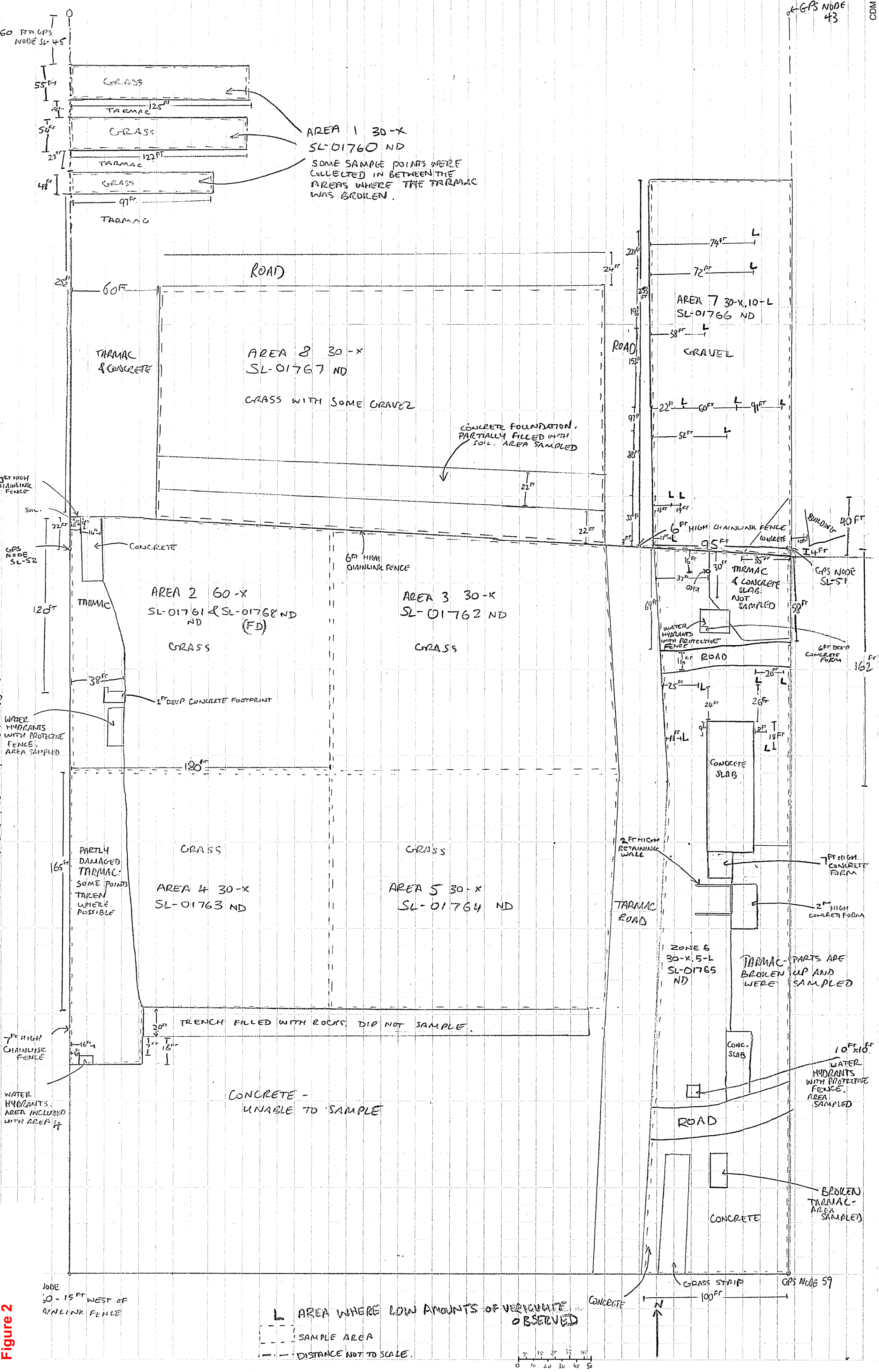
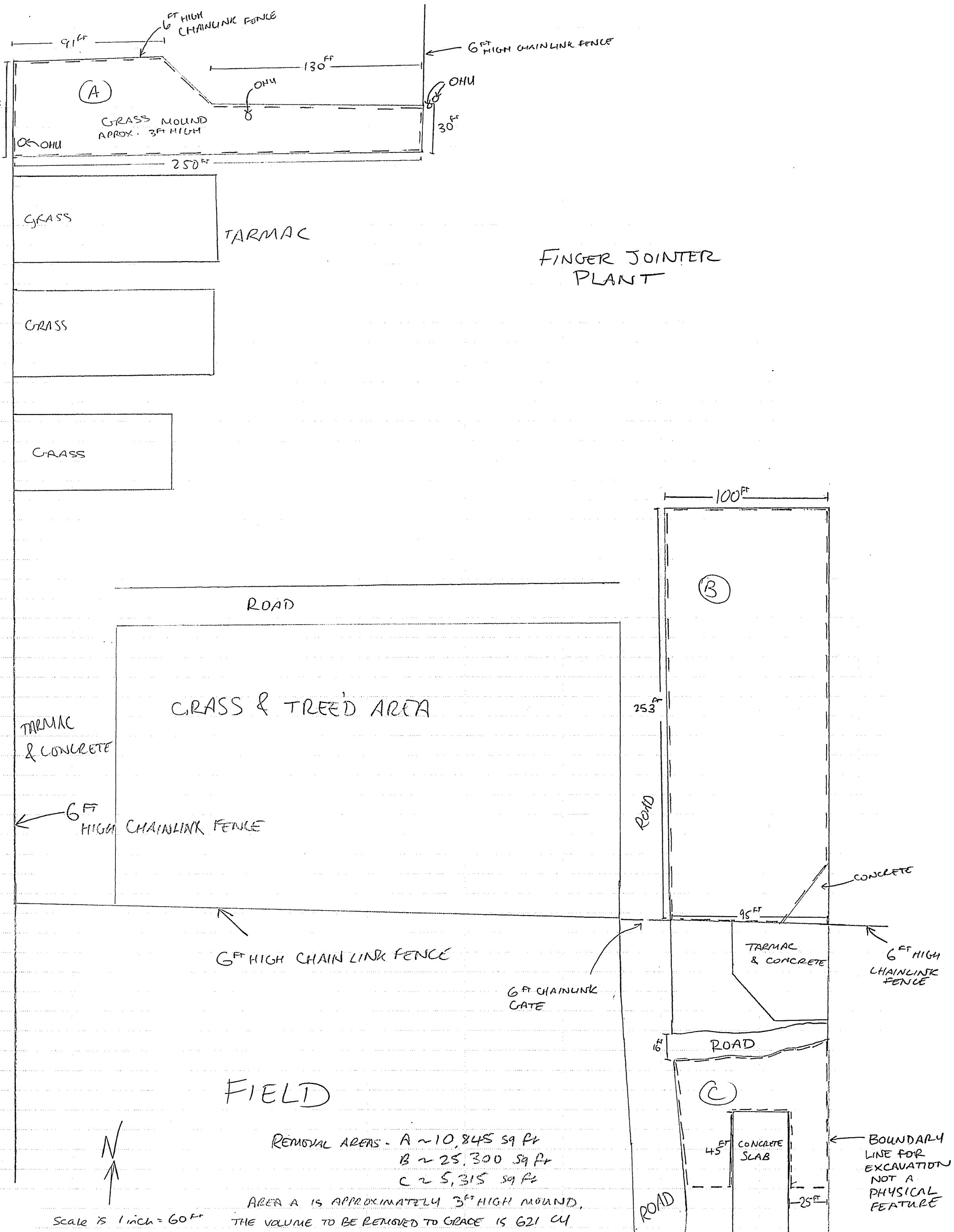


Figure 2

PROJECT LIBBY ASBESTOS
COMPUTED BY S. WILSON
875 US Hwy 2
JOB NO.
CHECKED BY
CLIENT VOLPE
DATE 5-1-09
DATE CHECKED
PAGE NO. 1 of 1



AREA A IS A 6" EXCAVATION - 201 cy.
- AREA A TOTAL REMOVAL AREA IS 822 cy
- AREA B IS A 12" EXCAVATION - 937 cy
- AREA C IS A 12" EXCAVATION - 197 cy
A TOTAL OF 1,956 cy

ALL RESTORATION IS TO BE STRUCTURAL FILL TO GRADE

CDM

Figure 3

Attachment A
Field logbooks, field sample data sheets, and visual vermiculite estimation form

AMC 4.20.09

Volpe/Libby Asbestos Project Logbook: 101093
Owner: STIMSON LUMBER Date: 4.20.2009
Address: 875 Highway 2S
Author: A.M. Crites Weather: Sunny 60°
Personnel: A.M. Crites, S. Wilson
Activities: SAMPLING & VISUAL INSPECTION
PPE: Level D Modified
All activities completed in accordance w/governing doc. PDIWP, SOP CDM-Libby-06, Rev.1, and SOP CDM-Libby-05, Rev. 2.

Trimble 6: ProXRS Asset Surveyor 5.27
Datalogger: 0220169420
Antenna: 0220173334
Receiver: 0220270969

AMC 4.20.09

1300 ON site to ~~colle~~ AMC 4.20.09 map out sample collection areas for site development plan, per Technical Memorandum - OU5 Re-development Area 04/17/09; Addendum - Initial Soils Data Gap Sample Collection Visual Vermiculite Inspection OU5, June 2008.
Sampling will consist of 8 field soil samples plus one field duplicate
Team investigates sample area and designates sample ~~areas~~ AMC 4.20.09 zones.
Some zones were decreased due

AMC 4.20.09

to large amounts of concrete and asphalt.
1420 Nick Raines, Field Team Leader, CDM, on site to approve zone size changes.
1425 N. Raines off site
1515 Team off site to update maps.
1600 Team on site to stake out sample zones, complete AHA form.
1430 Team off site ~~AMC 4.20.09~~

April 21, 2009

0935 A.M. Crites on site to begin sampling and visual inspection
Weather: sunny 45°; PPE: Level D, modified. A.M. Crites completes AHA form.
1015 S. Wilson on site to begin sampling and visual inspection
12:00 Team off site for lunch
13:00 Team on site to resume sampling
Visible vermiculite observed in ~~area~~ zones AMC 4.21.09 6 and 7.
No visible vermiculite in zones 1, 2-5, or 8.
Field duplicate collected in zone 2.

AMC 4.21.09

GPS points collected for all samples.
All equipment decontaminated between samples and IDW disposed of as ACM according to SOP.
The following samples were collected:
Zone 1: SL-01760, SP-136649, no visible; FSDS S-005457
Zone 2: SL-01761, SP-136650, no visible; FSDS S-005457
Zone 3: SL-01762, SP-136651, no visible; FSDS S-005457
Zone 4: SL-01763, SP-136652, no visible; FSDS S-005458
Zone 5: SL-01764, SP-136653, no visible in sample area FSDS S-005458
Zone 6: SL-01765, SP-136654, no visible in sample area FSDS-005458
4L in area south of E-W road. E of main road in north half of Zone 6
Zone 7: SL-01766; SP-136655, no visible in sample area FSDS S-005459.

AMC 4.21.09

875 Highway 2 ~~W~~ S Stimson Lumber

10 L visible in Zone 7. Sample collected in areas with no visible.

Zone 8: SL-01767, SP-136656, no visible.

Field Duplicate: SL-01768, SP-136650 no visible. Duplicate of SL-01761.

Photos taken of all areas

1520 T. Cook, Field Investigation Manager, on site to observe sampling and consult with team. Approved sampling in zones 6 and 7 where visible vermiculite was present, but not in sample points collected.

1555 T. Cook off site

1630 Team concludes sampling. All equipment decontaminated and IDW disposed of as ACM per SOP.

1655 Samples relenquished to Christy Gilbert and Tracy Dodge, Sample Coordinators under COC. AMC 4-21-09

$\boxed{\text{April 22, 2009}}$

0900 S. Wilson returns to site to collect measurements for WEF map.

1025 S. Wilson back in CDM office

relenquish logbook to S. Wilson

AM Cites Annmarie Cites

4-22-09

50889.67017.2616.015.202.DVOUS

Sheet No.: S- 005457

LIBBY FIELD SAMPLE DATA SHEET (FSDS) FOR SOIL

Field Logbook No: 101093 Page No: 19-21 Sampling Date: 4-21-2009

Address: 875 HIGHWAY 2 S Owner/Tenant: STIMSON LUMBER

Business Name: STIMSON LUMBER

Land Use: Residential School Commercial Mining Roadway Other ( )

Sampling Team: CDM Other ________ Names: S. Wilson, A.M. Crites

Data Item	Sample 1 ①	Sample 2 ②	Sample 3 ③
Index ID	SL- 01760 AMC	SL- 01761 AMC	SL- 01762 AMC
Location ID	SP- 136649 4.20.09	SP- 136650 4.20.09	SP- 136651 4.20.09
Sample Group	PROPERTY →		
Location Description (circle)	Back yard Front yard Side yard AREA 1 Driveway Other ________	Back yard Front yard Side yard AREA 2 Driveway Other ________	Back yard Front yard Side yard AREA 3 Driveway Other ________
Category (circle)	FS FD of ________ EB LB	FS FD of ________ EB LB	FS FD of ________ EB LB
Matrix Type (Surface soil unless other wise noted)	Surface Soil Other ________	Surface Soil Other ________	Surface Soil Other ________
Type (circle)	Grab Comp. # subsamples 30	Grab Comp. # subsamples 30	Grab Comp. # subsamples 30
GPS Status (circle)	Collected Previously Collected Not Collected-no signal (3 attempts) Not Collected-not required for sample	Collected Previously Collected Not Collected-no signal (3 attempts) Not Collected-not required for sample	Collected Previously Collected Not Collected-no signal (3 attempts) Not Collected-not required for sample
GPS File (fill in or circle)	Filename: T6A04219 NA	Filename: T6A04219 NA	Filename: T6A04219 NA
Sample Time	1030	1055	1140
Top Depth (inches below ground surface)	0	0	0
Bottom Depth (inches below ground surface)	6	6	6
Field Comments *Note if vermiculite is visible in sampled area*	BD- AD-000686 NO VISIBLE →	BD- AD-000686	BD- AD-000686
Entered (LFO) ____	Volpe: Entered ____ Validated ____	Volpe: Entered ____ Validated ____	Volpe: Entered ____ Validated ____

For Field Team Completion (Provide Initials)	Completed by: AMC	QC by: SW

vs 10507

50889. 67017. 2616. 015. 202. DV0U5

Sheet No.: S- 005458

LIBBY FIELD SAMPLE DATA SHEET (FSDS) FOR SOIL

Field Logbook No: 101093 Page No: 19-21 Sampling Date: 4.21.2009

Address: 875 Highway 2 S Owner/Tenant: STIMSON LUMBER

Business Name: STIMSON LUMBER

Land Use: Residential School Commercial Mining Roadway Other ( )

Sampling Team: CDM Other ______ Names: S. Wilson, A. M. Crites

Data Item	Sample 1 (4)	Sample 2 (5)	Sample 3 (6)
Index ID	SL- 01763 AMC	SL- 01764 AMC	SL- 01765 AMC
Location ID	SP- 136652 4.20.09	SP- 136653 4.20.09	SP- 136654 4.20.09
Sample Group	PROPERTY →	→	→
Location Description (circle)	Back yard Front yard Side yard AREA 4 Driveway Other ______	Back yard Front yard Side yard AREA 5 Driveway Other ______	Back yard Front yard Side yard AREA 6 Driveway Other ______
Category (circle)	FS FD of ______ EB LB	FS FD of ______ EB LB	FS FD of ______ EB LB
Matrix Type (Surface soil unless other wise noted)	Surface Soil Other ______	Surface Soil Other ______	Surface Soil Other ______
Type (circle)	Grab Comp. # subsamples 30	Grab Comp. # subsamples 30	Grab Comp. # subsamples 30
GPS Status (circle)	Collected Previously Collected Not Collected-no signal (3 attempts) Not Collected-not required for sample	Collected Previously Collected Not Collected-no signal (3 attempts) Not Collected-not required for sample	Collected Previously Collected Not Collected-no signal (3 attempts) Not Collected-not required for sample
GPS File (fill in or circle)	Filename: T6A04219 NA	Filename: T6A04219 NA	Filename: T6A04219 NA
Sample Time	1355	1330	~~1500~~ 1548 AMC 4.21.09
Top Depth (inches below ground surface)	0	0	0
Bottom Depth (inches below ground surface)	6	6	6
Field Comments *Note if vermiculite is visible in sampled area*	BD- AD- 000686 NO VISIBLE →	BD- AD-000686 →	BD- AD-000686 →
Entered (LFO) ____	Volpe: Entered ____ Validated ____	Volpe: Entered ____ Validated ____	Volpe: Entered ____ Validated ____

For Field Team Completion (Provide Initials)	Completed by: AMC	QC by: SW

vs 10507

50889.67017.2616.015.202.DVOU5

Sheet No.: S- 005459

LIBBY FIELD SAMPLE DATA SHEET (FSDS) FOR SOIL

Field Logbook No: 101093 Page No: 19-21 Sampling Date: ~~4-20~~ AMC 4.21.09 4-21-09

Address: 875 Highway 2S Owner/Tenant: STIMSON LUMBER

Business Name: STIMSON LUMBER

Land Use: Residential School Commercial Mining Roadway Other ( )

Sampling Team: CDM Other ________ Names: S. Wilson, A.M. Crites

Data Item	Sample 1 ⑦	Sample 2 ⑧	Sample 3 ⑨
Index ID	* SL- 01766 AMC	SL- 01767 AMC	SL- 01768 AMC
Location ID	SP- 136655 4.20.09	SP- 136656 4.20.09	SP- 136650 4.20.09
Sample Group	PROPERTY	→	→
Location Description (circle)	Back yard Front yard Side yard Driveway Other AREA 7	Back yard Front yard Side yard Driveway Other AREA 8	Back yard Front yard Side yard AREA 2 Driveway Other
Category (circle)	FS FD of ____ EB LB	FS FD of ____ EB LB	FS FD of ~~SL-01764~~ SL-01761 SW 4-21-09 EB LB
Matrix Type (Surface soil unless other wise noted)	Surface Soil Other ____	Surface Soil Other ____	Surface Soil Other ____
Type (circle)	Grab Comp. #subsamples 30	Grab Comp. #subsamples 30	Grab Comp. #subsamples 30
GPS Status (circle)	Collected Previously Collected Not Collected-no signal (3 attempts) Not Collected-not required for sample	Collected Previously Collected Not Collected-no signal (3 attempts) Not Collected-not required for sample	Collected Previously Collected Not Collected-no signal (3 attempts) Not Collected-not required for sample
GPS File (fill in or circle)	Filename: T6A04219 NA	Filename: T6A04219 NA	Filename: T6A04219 NA
Sample Time	1615	1125	1430
Top Depth (inches below ground surface)	0	0	0
Bottom Depth (inches below ground surface)	6	6	6
Field Comments *Note if vermiculite is visible in sampled area*	BD- AD-000686 NO VISIBLE * sample is valid TC 5/11/09	BD- AD-000686 NO VISIBLE →	BD- AD-000686 →
Entered (LFO) [initials]	Volpe: Entered ____ Validated ____	Volpe: Entered ____ Validated ____	Volpe: Entered ____ Validated ____

STET AMC 4.21.09

AMC 4.21.09

For Field Team Completion (Provide Initials)	Completed by: AMC	QC by: SW

vs 10507

LIBBY SUPERFUND SITE
Visual Vermiculite Estimation Form (VVEF)

Field Logbook No.: 101093
Page No.: 19
Site Visit Date: 4/21/2009
BD Number: AD-000686
Address: 875 Hwy 2 S
Structure Description: Property
Occupant: Stimson
Phone No.: _
Owner (If different than occupant): same
Phone No.: _
Investigation Team: S.Wilson, A.M Crites
Investigation Name: OU5 Redevelopment
Field Form Check Completed by (100% of Forms):
Visual Verification by Field Team Leader (10% of forms):

		Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 6	Zone 7	Zone 8
Type (SUA/CUA/LUA/ISA)		LUA	LUA	LUA	LUA	LUA	LUA	LUA	LUA
Description		PROPERTY	PROPERTY	PROPERTY	PROPERTY	PROPERTY	PROPERTY	PROPERTY	PROPERTY
Area Size (square feet)		18119	30600	28500	29700	31350	28900 (not including concrete)	24035	49600
General Comment (Cover, etc.)		GRASS	GRASS	GRASS	GRASS	GRASS	GRASS	STRUCTURAL FILL	GRASS
PIs (X=None, L=Low, M=Intermediate, H=High)	**X**	30	60	30	30	30	30	30	30
	L						5	10	
	M								
	H								
	Total	30	60	30	30	30	35	40	30

Areas previously identified for removal not inspected for visible vermiculite? **Yes** **Location(s): Area along north boundary of GPS node SL-45 and SL-43**

Attachment B
Analytical Results

FILE NAME: RESI_171988_PLM_VE.xls

Version : 7c

PLM VISUAL ESTIMATION DATA RECORDING SHEET

Laboratory Name	RESI	Data Entry by:	K. Carlaccini
Job Number	171988	Data Entry Date:	4/29/2009
Date Received	4/28/2009		
SOP Name/Revisi	SRC-LIBBY-03 (Rev 2)	QC Check by:	G. Vettraino
Spreadsheet version	7c	QC Check Date:	4/29/2009

							Stereomicroscopy Examination						Libby Amphibole (LA)			Other Amphibole (OA)			Chrysotile (Ch)				OPTICAL PROPERTIES FOR LA (see key for data entry inputs)								
EPA Index ID	Index Suffix Char.	Index Suffix No.	QA Type (NOT QA, LDS, LDC)	Lab Sample ID	Date Analyzed	Analyst Name	Sample Appearance	Qual	LA-MF (%)	Qual	OA/C-AF (%)	Ref Material (B or T)	Qual	LA-MF (%)	Bin	Qual	OA-AF (%)	OA Type (AMOS, ANTH, CROC, UNK)	Qual	Ch-AF (%)	Deviation?	Comments	Morph.	Fiber Color	Sign Elong. (+/-)	Pleoch. (Y/N)	Extinct. Angle	Ref. Index α	Ref. Index γ	Biref.	Optical Comments
SL-01760	FG	1	Not QA	413365	4/29/2009	RSW	Brown soil, fine						ND		A	ND			ND												
SL-01761	FG	1	Not QA	413366	4/29/2009	RSW	Tan soil, fine						ND		A	ND			ND												
SL-01762	FG	1	Not QA	413367	4/29/2009	RSW	Tan soil, fine						ND		A	ND			ND												
SL-01763	FG	1	Not QA	413368	4/29/2009	RSW	Tan soil, fine						ND		A	ND			ND												
SL-01764	FG	1	Not QA	413369	4/29/2009	RSW	Tan soil, fine						ND		A	ND			ND												
SL-01765	FG	1	Not QA	413370	4/29/2009	RSW	Tan soil, fine						ND		A	ND			ND												
SL-01766	FG	1	Not QA	413371	4/29/2009	RSW	Brown soil, fine						ND		A	ND			ND												
SL-01767	FG	1	Not QA	413372	4/29/2009	RSW	Tan soil, fine						ND		A	ND			ND												
SL-01768	FG	1	Not QA	413373	4/29/2009	RSW	Tan soil, fine						ND		A	ND			ND												

CDM

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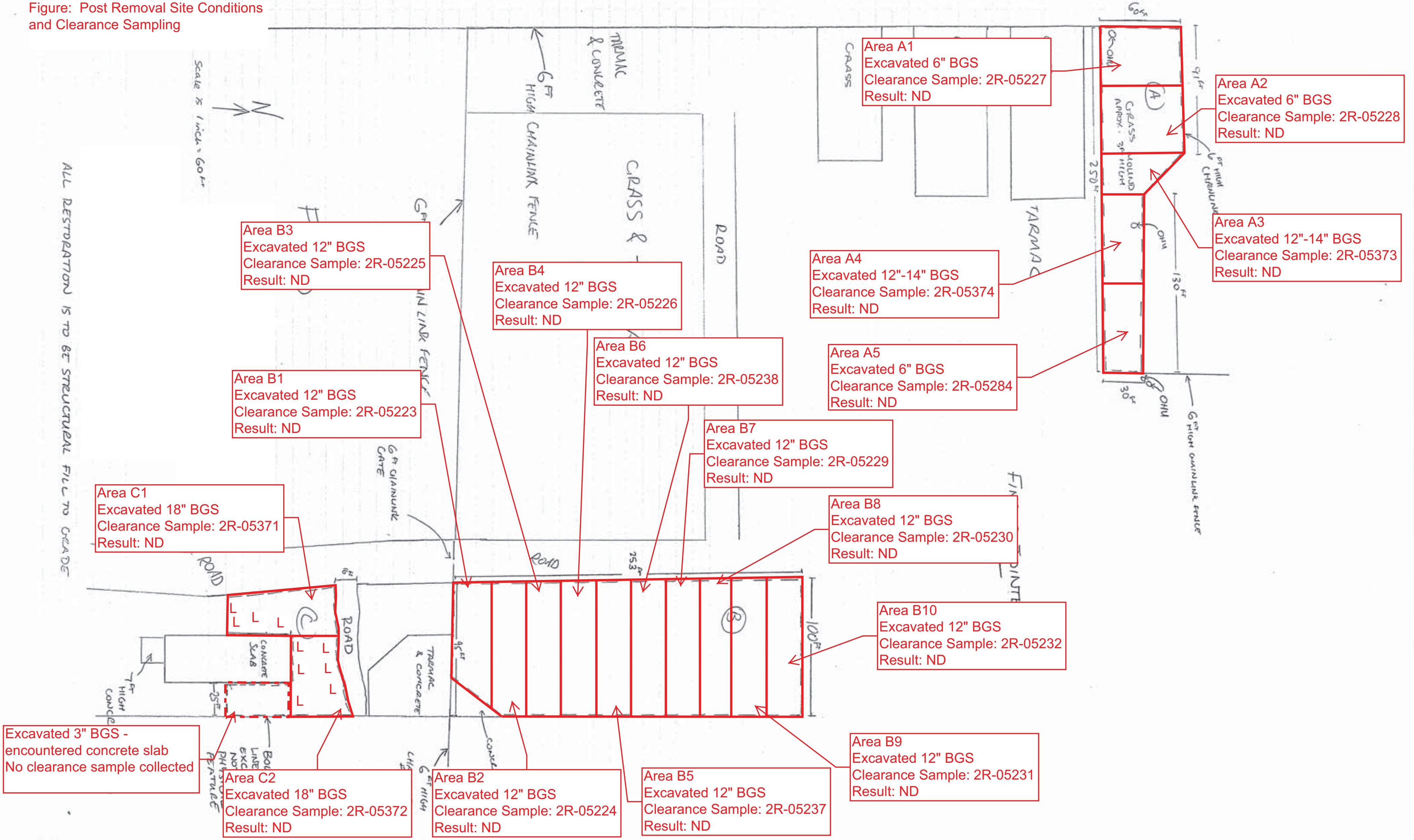
CLIENT VOLPE

DATE 06-01-09
DATE CHECKED
PAGE NO. 1 of 1

Figure: Post Removal Site Conditions and Clearance Sampling



Appendix A2
Addendum to the Response
Action Work Plan Central Maintenance Bldg

Addendum to the
Response Action Work Plan
Former Stimson Central Maintenance Building
Removal Plan

875 Highway 2 South

1.0 Introduction

This removal work plan is an addendum to the Response Action Work Plan (RAWP) (CDM 2003) and details specific information regarding removal activities that will take place at the Former Stimson Lumber Central Maintenance building, 875 Highway 2 South.

This plan includes building characterization data for the identification of vermiculite containing insulation (VCI), vermiculite containing building materials (VCBM), vermiculite containing soil (VCS), and evidence of Libby Amphibole (LA) asbestos in dust. Specific work to be performed on this property is also detailed on the following Contract Drawings:

- Former Stimson Central Maintenance Building Overall Site Layout - Figure 1
- Former Stimson Central Maintenance Building Interior Removal Plan - Figure 2
- Former Stimson Central Maintenance Building Exterior Removal Plan - Figure 3
- Former Mobile Shop Wall Details – Figure 4

All work on this property will be performed in consultation with the U.S. Environmental Protection Agency (EPA) On-Scene Coordinator (OSC) and in accordance with the RAWP and all other Contract Documents. All project quality assurance and quality control requirements for measurement reports will be addressed in a future data summary report.

2.0 Property Background

The following information was obtained from sampling activities and inspections performed by CDM at this property.

INTERIOR:

Overall Building Layout

- The Central Maintenance building is a rectangular, flat-roofed building, approximately 420 feet long and 142 feet wide.
- The entire building is constructed of timber main supports and wood framing. The ceiling and walls are finished with tongue and groove boards. The floor of the building is concrete slab on grade, containing several concrete vaults and pits. The roof has a 4-inch layer of aerated concrete on the tongue and groove ceiling covered by felt paper and tar.

- Walls throughout the building are constructed with 2-inch by 6-inch framing on 16-inch centers, and finished with 1-inch by 6-inch tongue and groove boards.

- The walls have equipment penetrating the wall cavities, and utilities running outside of the wall cavities.

- The building contains areas with varying wall heights. The building is separated into four areas for identification purposes relevant to this work plan (refer to Figure 1 for area locations):

    - Former Mobile Shop - a 45-foot tall structure, approximately 260 feet long and 54 feet wide, located on the north side of the building.

    - Former Engineering and Warehouse (E&W) Areas A and B – Two 15-foot tall structures, consisting of multiple spaces. A midline wall divides the two buildings along the east-west axis. The western portion of this area is currently occupied by a manufacturer of wood boilers called Seton Manufacturing. The location is shown on Figure 1.

        - Area A refers to the space north of the midline wall

        - Area B refers to the space south of the midline wall

    - Former Lift Truck Barn Area – the western portion of the building, separated from the other two areas by walls. This area is currently occupied by the business MAL Resources.

- A total of 29 dust samples were collected from all areas within the Central Maintenance Building to determine levels of LA asbestos. Analytical results for all but one dust sample are non-detect or below the level requiring cleaning for LA as directed by EPA. One dust sample collected from the Former Mobile Shop showed elevated levels of LA, necessitating cleaning of that room. Many additional rooms require spot cleaning of visible VCI, as defined and set forth in Section 4.2.

The designated areas are described in more detail below:

Former Mobile Shop

- The interior of the Former Mobile Shop is open space.

- All four walls of the shop contain VCI. However, the west wall is open from the ground up to approximately 20 feet. The area west of this opening is a bare storage area, with a lower roof, and is not considered to be part of the wall structure of the Former Mobile Shop.

- Walls in the Former Mobile Shop are vertically separated by 8-inch by 8-inch main supports into thirty-two, 20-foot wide bays. The bays are split into horizontal sections with 6-inch by 6-inch firebreaks. The wall studs divide a section into fourteen cavities. Each of these cavities contain VCI. See Figure 4 of the Contract Drawings.

- On the north wall, five of thirteen bays have 16-foot high (solid) doors; there are three wall sections above the doors which contain VCI. The remaining eight bays have four sections of wall containing VCI.

- On the south wall, the bottom section is a 19-foot high solid wall, constructed with back-to-back layers of vertical 1-inch by 6-inch tongue and groove boards. These sections do not contain VCI. The remaining two sections along the entire wall above the solid wall sections contain VCI.

- The south side exterior wall of the Former Mobile Shop has a layer of metal siding covering the tongue and groove boards. No VCI was observed within the space between the siding and the boards.

- There are two doors on the lower section of the east wall. The bay between the two doors is covered with plywood and contains fiberglass insulation in the wall cavity. The plywood is in poor condition, and the fiberglass insulation is not well contained. VCI remnants may also be present in this area of the wall.

- The upper two sections of the east wall contain VCI. The sections, combined, are about 20 feet high, and are accessible from a catwalk. A 35-ton crane and a 15-ton crane are near this wall. Two steel (2-inch diameter) cross braces across the ceiling also exists on the east wall. The braces may obstruct access to the highest wall section of north and south bay 1. The cleanup/construction contractor shall leave the braces in place, at all extent possible. If the braces require removal in order to access all VCI, they will require replacement upon completion of remediation activities.

- The west side of the room has no wall up to a height of approximately 20 feet. There are three wall sections with VCI, one below and two above the catwalk. All areas are accessible; although, there are two steel (2-inch diameter) cross braces across the ceiling that obstruct access to the highest wall section of north and south bay 13. The cleanup/construction contractor shall leave the braces in place, to the extent possible. If the braces require removal in order to access all VCI, they will require replacement upon completion of remediation activities.

- VCI is located on interior surfaces throughout the Former Mobile Shop. VCI has leaked out of the walls and collected on the crane track and supports in the Former Mobile Shop, as well as onto shelves and other horizontal surfaces.

- Subsurface vaults are located throughout the Former Mobile Shop floor. A number of them contain VCI remnants within the vaults.

- A small cinder block building is attached to the exterior of the north wall, accessible from inside the Former Mobile Shop. No VCI was observed in this area.

Former Engineering and Warehouse Area

- The Former E&W Areas A and B are divided by a midline wall. The wall is not continuous across the entire length of the building; there are doorways and openings that divide the wall into sections.
- Portions of the midline walls are finished with plywood instead of tongue and groove boards. The walls contain VCI or remnants of VCI. The walls are separated into horizontal sections with 6-inch by 6-inch beams as firebreaks.
- Penetrations and remodeling at the midline wall has caused VCI to be released on either side of the wall.
- VCI is located on interior surfaces throughout the Former E&W Area A, including shelf units and other horizontal surfaces.
- VCI in the Former E&W Area B is limited to small quantities against the wall that have leaked from penetrations and remodeling.
- Seton Manufacturing currently occupies rooms 13-1, 16-1, 18-1, 10-3, 11-3, 12-1, and 12-5. They also use room 8-3, which is a bathroom. They have access to rooms 17-2 and 17-3 but do not use these spaces.
- According to information gathered during the pre-design inspection, the interior area currently occupied by Seton Manufacturing (formerly Rohar Industries) was cleaned by the following methods. The floors were reportedly swept, power washed, and the lower few feet of the walls were power washed. In addition, Murphy's soap was reportedly used on the walls of the offices and bathroom (rooms 8-3, 10-3, 11-3, and 12-5). During inspections conducted by EPA for this Work Plan, no VCI was observed in the Seton Manufacturing area. An interior cleaning will not be required in this area; however, spot cleaning, as defined in Section 4.2, may be required in areas adjacent to the wall where VCI has since leaked from the midline wall.
- VCI was not observed on the second floor balcony in this area.

Former Lift Truck Barn

- This area includes room 19-1.
- VCI was not observed in this area of the building.
- The Former Lift Truck Barn, room 19-1, is occupied by MAL Resources, for the purpose of washing and stacking decorative stone. One wall of room 17-2 is adjacent to the Former Lift Truck Barn. This room contains equipment that may make VCI removal from the walls difficult in this space. Access to the VCI in the shared wall between rooms 17-2 and 19-1, will be made from room 19-1. Removal methods and coordination with MAL Resources are discussed further in Sections 3.1, 3.2, and 4.0.

- One dust sample was collected from the Former Lift Truck Barn area. Analytical results for the sample were non-detect for LA asbestos.

<u>EXTERIOR:</u>

<u>Roof</u>

- Building roofing material on the Former Mobile Shop is composed of an approximate 4-inch layer of aerated concrete atop the tongue and groove ceiling of the building. On top of the concrete is a layer of tar, followed by a layer of tar paper.

- The roof of the Former Mobile Shop has significant damage; the tar paper has been removed or damaged on about 30% of the roof, confined mostly to the south and east areas of the roof. This area has been covered with a tarp (see Figure 3). Inspection of the roof under the tarp revealed that most of the aerated concrete is intact, with the exception of about one-third of the material which is severely degraded and wet. The damaged material is concentrated in the south side of the repaired area.

- The eastern quarter of the Former Mobile Shop roof is covered with corrugated metal siding. There is no indication of the condition of the aerated concrete under the siding.

- Friable concrete debris is scattered around this area of the roof and on the tar paper torn from the roof.

- Three bulk samples were collected of the aerated concrete roofing material of the Former Mobile Shop. Analytical results for all three samples reveal less than 1 percent LA asbestos.

- The roof of the Former E&W Area A is also made of the same VCBM, however subsequent sampling indicates that these areas are non-detect for Libby Amphibole.

- Pallets along the wall of the Former Mobile Shop and adjacent to the Former E&W Area A roof have been contaminated with VCBM debris.

- The roof of the Former E&W Area B and the raised E&W area roof do not contain aerated concrete VCBM.

- The entire roof of the Former E&W Area (lower roof) is undamaged and in good condition.

- VCI and VCBM debris is present on all roof areas, with the exception of the Former Lift Truck Barn roof.

- All areas of the roof can be accessed by ladders. Locations are shown on Figure 3.

<u>Vaults</u>

- There are two subsurface features along the exterior east side of the building: a vault under a surface-level hatch located on the south east corner, and a vault under a wooden shack on the far eastern corner of the north side.

- The shack is constructed of a single wall of 1-inch by 6-inch tongue and groove boards, and is in very poor condition. The shack is a 5-foot by 4-foot structure with an open bottom, resting on a concrete vault approximately 8 feet deep. Piping in the vault is covered in part with damaged suspect asbestos containing material (ACM) pipe insulation. VCI is scattered throughout the vault, which has leaked from the Former Mobile Shop walls.

    - The vault located at the south end of the east side of the building is constructed with a soil floor and creosote-treated railroad tie walls. Vermiculite was observed in the soil floor of this vault.

    - One soil sample was collected from the floor of the southeast vault. Analytical results for this sample were non-detect for LA asbestos.

Perimeter Soil

- VCBM debris is scattered on the surface soils along the north and east sides of the building. The source is the damaged roof of the Former Mobile Shop. The debris is scattered on the ground along a 30-foot perimeter of the east and north sides of the building.

- VCI has also leaked from the Former Mobile Shop north wall and was observed in piles against the exterior north wall of the building.

- The soils located around the footprint of the building do not contain visible vermiculite, except in the southeast vault as previously discussed.

- Three soil samples were collected from the north and east perimeter of the building. Analytical results for the samples were non-detect for LA asbestos.

3.0 Health and Safety

- All removal activities at the Former Stimson Lumber Central Maintenance Building must be performed in accordance with the Libby Comprehensive Health and Safety Plan (CHASP), regulations set forth by the U.S. Occupational Safety and Health Administration's (OSHA) Title 29 Code of Federal Regulations (CFR) Parts 1926.

- All removal activities will be performed in Level C PPE as defined in the CHASP. Respiratory protection for removal activities will require use of Powered Air Purifying Respirators (PAPR's) equipped with P-100 HEPA cartridges. Personal breathing zone air samples will be collected characterizing task related personal exposures during all phases of the removal work.

- Perimeter air samples will be collected around the exclusion zone (EZ) boundary during the removal of the Former Mobile Shop roof. The southern boundary of the EZ will require the perimeter air sample to be collected on top of the lower roof south of the Former Mobile Shop roof. The north, east and west boundary of the EZ will be monitored at the ground level. Perimeter air monitoring will be completed as outlined in the RAWP.

- The cleanup/construction contractor shall submit a detailed, site-specific Health and Safety Plan for approval by the On-Scene Coordinator and the oversight contractor, prior to the start of work. Included in this Health and Safety Plan shall be written procedures for the following specific items:

  - Electrical Safety and Lock Out/Tag Out (LOTO) procedures that must be implemented by a certified electrician

  - Power Industrial Lift Truck Operations

  - OSHA 29 CFR 1926 Fall Protection

- The Former Mobile Shop roof is a low slope roof. A low sloped roof is defined as a roof having a slope less than or equal to 4 in 12 (vertical to horizontal).

- The cleanup/construction contractor shall comply with all confined space entry regulations and procedures if entry into any of sub-surface features, vaults or any other confined spaces on the site is required to perform the work set forth in this Work Plan.

- Containment areas will be constructed to segregate removal areas from the existing businesses that will be operating during removal activities. Containments must be designed according to OSHA's Class I containment specifications as listed in CFR 1926.1101, and must be constructed achieve the following requirements:

  - Negative air must be sufficient to change out the containment air volume at least 4 to 5 times per hour.

  - Negative air must be great enough to achieve a -0.02" H_2O pressure differential between containment and outside air.

  - Contamination must be pulled away from worker's breathing zone.

- Once the containment is constructed, a hazard analysis form will be completed by the Government representative to ensure compliance with all applicable Contract Documents. The Government Representative or oversight contractor will perform a smoke test in all areas of containment prior to start of work to ensure that the negative air system is sufficient to assure that asbestos fibers do not migrate to adjacent areas.

- The containment must be inspected by the cleanup/construction contractor's competent person at the beginning of each work shift to ensure the negative air system is operational and that the containment has not been breached or damaged in any manner. Any damage or breaches identified during the inspection must be repaired prior to start of work.

- Stationary air samples will be collected in both business work areas during removal operations to ensure that asbestos fiber migration is controlled. One air sample will be collected in the MAL Resources business area (19-1) during the VCI removal from the walls in room 17-2. Up to three stationary air samples will be collected in the Seton Manufacturing business area (13-1, 16-1, 18-1, 10-3, 11-3, 12-1, and 12-5) during VCI removal from the midline wall. All stationary air samples will be collected in accordance with the Contract Documents.

3.1 Coordination with Businesses

- Two businesses are currently located inside the Former Stimson Building, MAL Resources and Seton Manufacturing. See Figure 1 for locations.

- The businesses will remain operational during the removal activities, to the extent possible. The cleanup/construction contractor will coordinate with the Government representative, the oversight contractor, and the business owners to minimize the disturbance to the businesses during normal working hours.

- Electricity that is supplying the business owners will remain on during business hours during the remediation activities to the extent practical, so as to minimize disturbance to the business operation. If power must be shut down an alternative power source shall be provided to the affected businesses by the cleanup/construction contractor. There is no evidence of electrical wiring inside of the midline walls; however, the cleanup/construction contractor will take care when penetrating walls to ensure that no electrical conduits are encountered.

- The business owners will be briefed by the Site Health and Safety Officer (SHSO) on the removal activities, controlled areas, and health and safety requirements to be followed by all government employees and contractors. The business owners will be responsible for informing their employees of any requirements and restricted areas

- Additional air samples will be collected by CDM to ensure that asbestos fiber migration is prevented into the workers' areas, as discussed above.

<u>MAL Resources</u>

- MAL Resources currently occupies room 19-1, as shown on the Contract Drawings.

- The employees will be able to access their southwest single access door as well as their north large bay door during the duration of the remediation, except during VCI surficial vacuum of the soils along the perimeter of the building. This disturbance is minimal, and the cleanup/construction contractor shall coordinate with MAL Resources during the exterior activities to ensure that they will be able to transport their trucks in and out of the building, as necessary.

- The cleanup/construction contractor will also coordinate with MAL Resources when setting up containment around the western wall of room 17-2. This set-up will be done after business hours or on weekends to minimize disturbance to the employees.

<u>Seton Manufacturing</u>

- Seton Manufacturing currently occupies rooms 13-1, 16-1, 18-1, 10-3, 11-3, 12-1, and 12-5. They also use room 8-3 which is a bathroom. They have access to rooms 17-2 and 17-3, but do not use these spaces.

- The cleanup/construction contractor will coordinate with Seton Manufacturing when setting up containment around the southern side of the midline wall. The owner has agreed to move any equipment located next to the walls that are in the way of containment.

- The containment set-up will be done after business hours or on weekends to minimize disturbance to the employees, if necessary.

- The employees will have access to all their exterior doors during the duration of the remediation.

- Room 8-3 is the restroom used by Seton Manufacturing employees. The VCI in the midline wall associated with this room will be cleaned and the room cleared for use in coordination with Seton Manufacturing. The closure of this room will be minimized in order to allow Seton Manufacturing use of room 8-3 during their operating hours to the extent practicable. The cleanup construction contractor shall provide portable toilets and hand washing stations for use by Seton Manufacturing's employees for the period when the restroom is not available to them.

3.2 Containment

Containment systems must be constructed prior to the start of interior cleanup work. The building walls and ceiling require cleaning and will not be covered with 6-mil polyethylene sheeting. The building walls and ceiling will act as part of the negative pressure enclosure (NPE) and will not require coverage. The systems shall be set up as follows:

- The Former Mobile Shop will be delineated into multiple separate NPEs.

    - All doors and openings within each NPE in the Former Mobile Shop will be covered with 6-mil polyethylene sheeting. During the construction of the west NPE within the Former Mobile Shop the open west end will be covered with 6-mil polyethylene sheeting to prevent migration of asbestos fibers from the work area.

- Containment in Rooms 7-1, 8-1, 8-2, 8-3, 9-1, 10-1 will be constructed in the same manner as in 1-1 and 4-1, and, at a minimum, be ten feet north of the wall. In rooms 11-2 and 12-1 south of the Former Mobile Shop will be isolated to form a separate NPE the containment will be constructed, at a minimum, ten feet south of the wall. This will be coordinated with Seton Manufacturing as necessary.

    - The south side of the midline wall will be contained as the southern boundary of the NPE. A 6-mil polyethylene sheeting containment wall will be constructed approximately 10 feet south of the midline walls, which will be coordinated with Seton Manufacturing.

- The walls containing VCI in Room 17-2 will be isolated to form a NPE. Removal of VCI from this wall will be completed from the west side, in room 19-1. This containment will be constructed of 6-mil polyethylene sheeting extending approximately 10 feet west of the wall containing the VCI. The use of this area (within room 19-1) will be coordinated with MAL Resources, as to prevent disruption to their business.

- Room 1-1 will be isolated forming a NPE. Removal of remnant VCI will be conducted from the inside of room 1-1. A separate NPE will be constructed encompassing the midline wall extending into room 4-1.

- Room 8-3 is a restroom used by Seton Manufacturing employees. The room will be checked and any conduits, cracks, or penetrations into the north, east, and west walls will be sealed with a combination of poly sheeting and caulk in order to seal the room off from adjoining spaces. Once work activity on the midline wall in contact with room 8-3 is complete, that area will be cleared and the containment modified to allow access to room 8-3 by Seton Manufacturing employees.

- HEPA filter equipped air handling units will be placed in locations and quantity that creates a NPE in accordance with the requirements included in the RAWP.

- Clearance Criteria for all areas on the site (interior containments, interior spot cleanings, roofs, vaults, floors, exterior soils, etc.) shall be determined in consultation with the On-Scene Coordinator. Clearance methods and protocols shall also be determined in consultation with the On-Scene Coordinator.

4.0 Remediation Activities

Remediation activities must be carried out in a manner that ensures cleaned areas are not re-contaminated during work activities. To accomplish that goal, work will be performed in the following order:

- Exterior Roof Remediation
- Soil Excavation/Surface Vacuum
- VCI Bulk Removal/Spot Cleaning (to be performed simultaneously)
- Interior Cleaning/Interior Vault Remediation (to be performed simultaneously)
- Encapsulant Application (to be performed simultaneously)
- Exterior Vault Remediation

4.1 Exterior Roof Remediation

The following activities will take place on the roof of the building:

- The entire Former Mobile Shop roof will be removed and replaced with a comparable roofing material.

- The Former E&W Area A is made of the same material as the Former Mobile Shop; however, it is undamaged and does not pose a risk of an imminent release. Therefore, it will not be removed. The Former E&W Roof area B, the Former Lift Truck Barn Roof, and the Former E&W area higher roof (refer to Figure 3) do not contain VCBM aerated concrete roofing material.

- All work performed by the cleanup/construction contractor on the roofs shall be done in consultation with the EPA On-Scene Coordinator, the site Health and Safety Officer, the oversight contractor, and in accordance with this Work Plan.

- No enclosures will be constructed during the removal of the vermiculite containing aerated concrete roofing material. An exclusion zone (EZ) will be delineated at the ground level on the north, east and west boundaries of the Former Mobile Shop. The lower roof south of the Former Mobile Shop will be the southern boundary for the EZ.

- The corrugated metal sheeting covering the eastern quarter of the Former Mobile Shop will be removed, washed and disposed of as construction debris. A layer of tar paper may be located between the aerated concrete and the corrugated metal sheeting. Any tar paper removed prior to the removal of the aerated concrete will be disposed of as ACBM.

- Either a wet cut-off saw or a circular saw equipped with HEPA equipped local exhaust ventilation will be used to score the layer of aerated concrete. The scoring should reach a depth of up to 4 inches into the layer of aerated concrete prior to removal. Great care should be taken when placing these scoring lines to ensure the bottom wooden roof deck remains undamaged. This method allows for the concurrent removal of the aerated concrete and the tar paper that is also part of the roof structure (as this tar paper contains remnants of the aerated concrete stuck on its' surface).

- Either manual scraping bars or a power assisted scraping machine will be used to lift the layer of roofing material off the wooden roof deck. During this scraping operation, wet methods will be used to limit generation of airborne dust.

- A debris chute will be constructed leading from the roof into a hazardous waste container. The shoot will be placed under negative pressure by attaching a negative air filtration unit inline on the bottom of the shoot to ensure dust is pulled into the shoot during disposal of the roofing material.

		
Former Mobile Shop roof, facing east. Damaged area repaired with tarps and nailed down 2" by 4" wood.	Former Mobile shop roof, facing west, showing extent of heavily damaged areas.	Cross-section of roof as seen at the ladder up to Former Mobile Shop roof – tarp on top of damaged VCBM, over tongue-groove ceiling

- The following roof areas will be surface vacuumed after the completion of the upper roof: entire lower (Former E&W Area) roof including the roof area west of the upper roof and the raised roof area that is approximately 10 feet higher than the lower roof area. See Figure 3 for locations. Mechanical means may be used in these areas as well. The only roof area not requiring vacuuming is the Former Lift Truck Barn roof.

- The pallets that line the edge of the Former Mobile Shop on the lower roof will be washed to remove all surficial material and returned to their original location.

		
Lower roofs, facing west – these roofs are not damaged – the northern half has VCBM, southern half does not.	VCBM is seen as both debris and pulverized into powder, collecting at low points including around pipe penetrations (vents).	A row of pallets lines the edge of the lower roof adjacent to the Former Mobile Shop. These are to be washed and returned to their original location.

4.2 Interior Remediation

Once the roof has been cleaned and replaced, removal of bulk VCI will take place inside the building, followed by interior cleaning and encapsulant application.

VCI Bulk Removal

- Prior to VCI removal, all large equipment items, including the two large cranes in the Former Mobile Shop, will be cleaned to remove all surficial VCI and left in place. All equipment will be covered with polysheeting during the remainder of interior remediation to protect it from being re-contaminated.

- VCI will be removed from all walls containing the material. Specifically, VCI will be removed from the following walls (see Figure 2 for locations):

    - All Former Mobile Shop walls
    - All midline walls
    - Eastern wall of room 1-1
    - Western wall of rooms 17-2 and 17-3

  VCI will be removed using vacuum methods. Vacuum methods consist of using a HEPA equipped vacuum truck with a storage container in line.

- The fiberglass insulation in the east wall of the Former Mobile Shop (located in between the two bay doors) will also be removed, as it is not well contained behind the plywood wall and may contain VCI remnants. The plywood wall will be removed and disposed of as contaminated material. The plywood will be replaced with a similar comparable material.

Former Mobile Shop

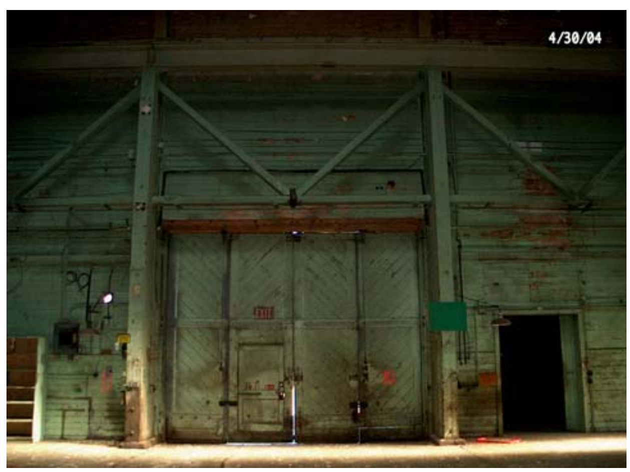
- In the Former Mobile Shop, A 6-inch diameter hole will be drilled into the tongue and groove boards in between each framing cavity to access the VCI (14 cavities per section per bay; 3 to 4 sections per bay). Adapters will be placed on the end of the vacuum hose to remove VCI from corners of the framing cavity.

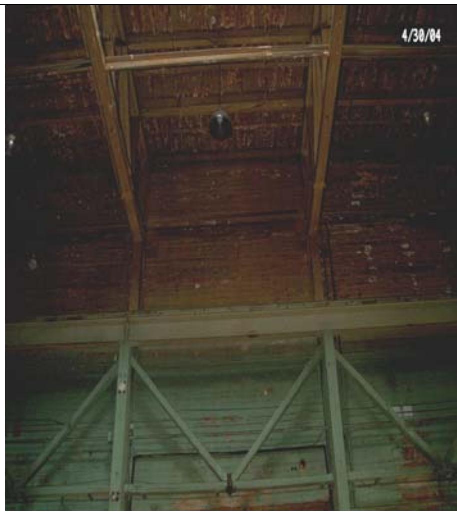
- The majority of the Former Mobile Shop walls will be accessed using a man-lift with a retractable boom.

    - All bays on the north and south walls are accessible using the man-lift; this method was used successfully to access the bays during inspection.

    - Upper bays on the east and west wall can not be reached by the man-lift due to obstacles such as large cranes. These bays can be accessed from a catwalk on either side of the building.

    - The cleanup/construction contractor shall leave the 2-inch diameter steel bracing at the east and west ceiling in place, to the extent possible. Extra time may be required in order to access the wall sections that are located near the bracing. If removal of the bracing is required to access all VCI, the bracing will require replacement upon completion of remediation activities.

	
North side bay 13, note obstacles to work area. The stairway accesses the catwalk on the west side of the Former Mobile Shop.	North side bays 11, 10, 9 from left to right. A door and solid wall are at lower section of bay 10, Wall cavities with VCI are in all of bays 9 and 11. Trusses for crane track in front of all wall bays.



Typical upper section of bays. Note steel beam and trusses along north and south side, this feature is for the 35 ton crane stationed on the east side of shop. VCI has settled onto many of the horizontal surfaces.

West wall of the Former Mobile Shop. The catwalk is located where the color changes from green to brown. Steel bracing is at the ceiling in northeast and southeast corners, but is not visible in this photo.

Typical south bays, photo shows bays 8 and 9. The lower 19 ft. wall sections are solid in all south bays.

South side bay 12, showing some of the typical obstacles, penetrations, and utilities in the work areas.

Former E&W Areas

- VCI within the midline wall cavities, as well as rooms 1-1, 17-2 and 17-3, will be accessed using stepladders or platforms.

- The west wall of room 17-3 will be accessed and remediated through the west side of the wall.

- Holes will be drilled in these walls to access the VCI in the same manner as the walls of the Former Mobile Shop.

<table>
<tr>
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<tr>
<td>Room 1-1 (Fig 1). Midline wall. Walls in this room are accessible from a stepladder. These walls may contain full or remnant VCI.</td>
<td>Room 17-2. These walls have full or remnant VCI, and are in a small room with a fixed furnace.</td>
</tr>
</table>

Spot Cleaning

- Spot cleaning will consist of HEPA vacuuming, mopping floors, and wiping down horizontal surfaces, etc. in areas containing visible VCI but not requiring a full interior cleaning of the entire room/area.

- Spot cleaning of VCI will be completed along the south side of the midline wall and other areas within the building as necessary.

- Spot cleaning will be done in conjunction with bulk cleaning, in a manner that does not cause cross contamination between cleaned and contaminated surfaces.

Interior Cleaning

- Following bulk VCI removal, the entire Former Mobile Shop will require interior cleaning, including the lower roof Former Mobile Shop area, due to the large quantity of visible VCI located throughout the interior surfaces of the shop.

- All interior cleaning shall be performed in consultation with the On-Scene Coordinator and the oversight contractor and in accordance with this Work Plan. Strategies for the interior cleaning shall include the combined use of the HEPA vacuum, wet-wiping, and power washing of all interior surfaces within the Former Mobile Shop. The cleanup/construction contractor shall use Best Management Practices for managing and disposing of wash water and waste water generated during cleanup activities.

- Since all dust samples collected within the building were below the levels requiring cleaning as directed by EPA, no additional rooms besides the Former Mobile Shop will require interior cleaning.

- During interior cleaning of the Former Mobile Shop, all interior vaults and pits will be opened and inspected. Vaults or pits containing water and/or sludge will not be cleaned. Any dry vaults or pits will be cleaned of debris, and vacuumed to remove VCI.

- Locations of a few vaults are included in Figure 2. The cleanup/construction contractor will also inspect additional vaults and pits that are discovered during work activities and are not included on the figure.

- The cleanup/construction contractor shall comply with all confined space entry regulations and procedures if entry into any of sub-surface features, vaults or any other confined spaces on the site is required to perform the work set forth in this Work Plan.

- Clearance Criteria for all areas on the site (interior containments, interior spot cleanings, roofs, vaults, floors, exterior soils, etc.) shall be determined in consultation with the On-Scene Coordinator. Clearance methods and protocols shall also be determined in consultation with the On-Scene Coordinator.

	
Some vaults have water/sludge and do not require cleaning.	This pit is dry and has some debris, requires cleaning by disposing of debris and vacuuming pit. This is at the middle of east wall.

Encapsulant Application

- After the VCI has been removed and the work area inspected by an onsite Government representative for completeness of dust removal, encapsulant will be applied to all wall cavities that had contained VCI. Encapsulant will also be applied to exterior surfaces to ensure any remaining asbestos fibers are sealed in place. Encapsulant will not be directly applied to the floor of the Former Mobile Shop.

- Clear encapsulant material will be required in all areas requiring application of encapsulant.

4.3 Exterior Vault Cleaning and Soil Excavation

Once remediation activities are completed on the roof and inside the building, the remediation activities along the exterior perimeter of the building will commence. This will ensure cross-contamination does not occur. The following areas require remediation:

Shack and Northeast Vault

- The shack will be dismantled prior to entry to ensure the safety of workers.
- The shack materials will be properly disposed of as ACM.
- Piping inside the shack will be protected and supported, as necessary.
- All suspect ACM insulation from the pipes will be removed and properly disposed.
- The vault located in the floor of the shack will then be remediated. Confined space entry procedures may be applicable for entry into this vault. Any debris inside the vault will be discarded as ACM.
- VCI within the vault will be removed with vacuum methods.
- Encapsulant will then be applied to the walls, floor, and piping within the vault.

The shack is located on the east end of the north side of the Former Mobile Shop (refer to Fig 2), and has VCI inside and on the ground outside. The shack will be dismantled and discarded.

Inside the shack – piping with remains of suspect ACM insulation. The insulation will be discarded as ACM.

Looking into the vault – VCI is scattered throughout this area – discard all debris within this vault – wash down and surface vacuum interior, apply encapsulant.

Southeast Vault

- The vault on the southeast corner of building has vermiculite in the soil floor. However, soil samples reveal that LA asbestos is non-detect. Therefore, no remediation will be required to the soil floor of the vault.
- Any remnant VCI located on the surface of the soil floor will be vacuumed.
- Confined space entry procedures may be applicable for entry into this vault.

Entrance to vault on the south east corner of the building. The Vault has creosote timber walls and a soil floor.

Floor of the vault as viewed from the entrance.

Exterior Soil

- Excavation along the perimeter of the building will not be required, as analytical results of soil samples taken in the perimeter areas reveal that LA asbestos is non-detect.
- However, surficial VCBM and VCI located on the top of the soil along the north and east sides of the building will be removed by vacuum methods, from the edge of the walls and outward approximately 45 feet.
- Items located within the work area, such as the racks and shelving will be left in place and protected during surficial removal.

		
North side of Former Mobile Shop facing west, from the east end.	North side of Former Mobile Shop facing east, from the west end.	East side of Building, note the shed/shelves and pipe rack against the wall – the shed has no floor.

5.0 Restoration Activities

Restoration activities at this property will consist of performing the following work:

- Roof
  - Previously discussed in Section 4.1.
- Former Mobile Shop
  - Blown-in fiberglass will be installed in all exterior walls of the Former Mobile Shop, which includes the entire north and east walls, and the upper portion of the south and west walls.
  - All holes that were made in the walls to access the VCI will be repaired and sealed.

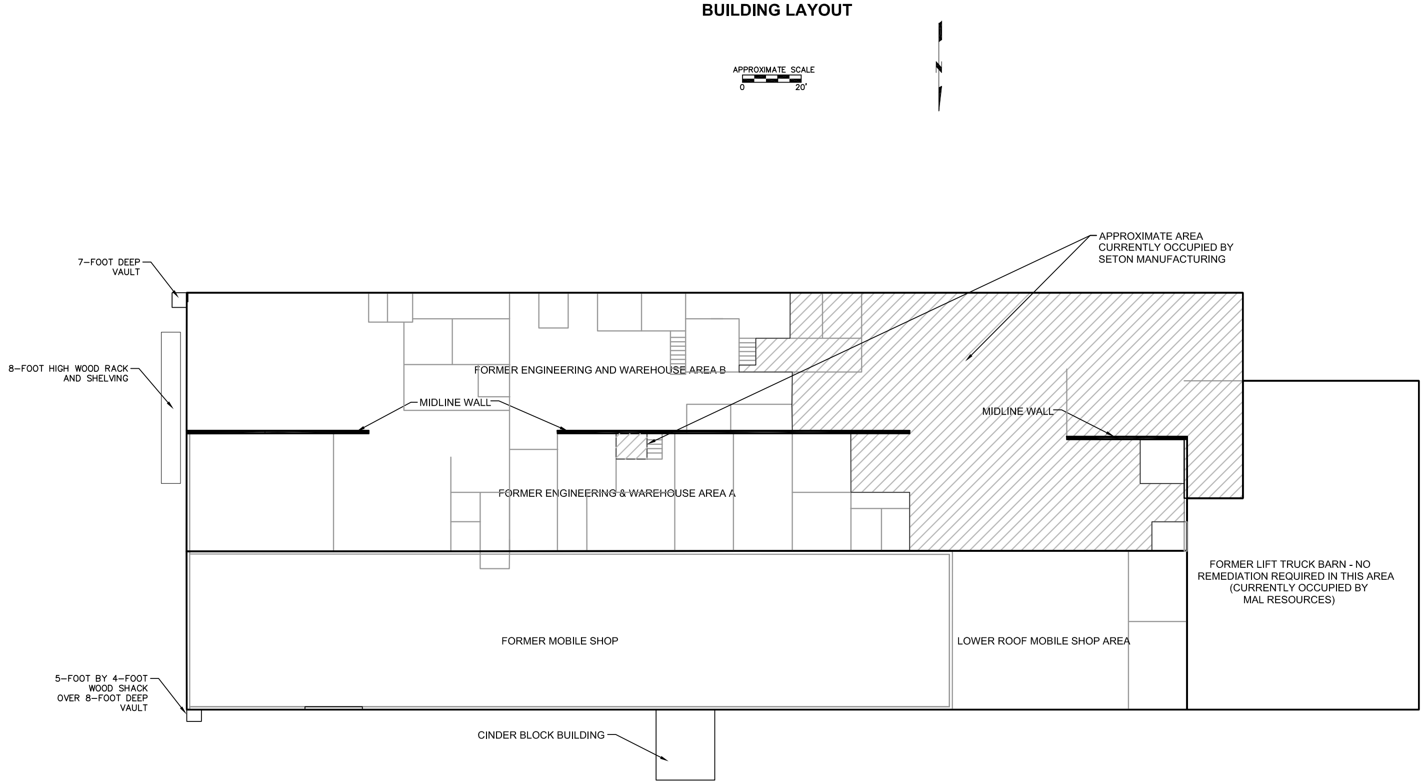
- Former E&W Areas A and B
    - Blown-in fiberglass will be installed in the eastern wall of room 1-1. The interior walls, including the midline wall and walls of rooms 17-2 and 17-3, will not be insulated.
    - All holes that were made in the walls to access the VCI will be repaired and sealed.
- Shack and northeast vault
    - The shack will not be re-built.
    - A cover will be constructed over the vault for safety purposes, constructed of plywood and a 2-inch by 4-inch frame to fix the plywood into place, and cement or steel anti-collision posts will be placed to protect the vault from vehicular traffic.

6.0 References

CDM. 2003. Response Action Work Plan (RAWP), EPA Libby Asbestos Project, Libby, Montana. November.

CHASP. Libby Comprehensive Health and Safety Plan, EPA Libby Asbestos Project, Libby, Montana. May 2003.

BUILDING LAYOUT



GENERAL NOTES:

1. BUILDING LAYOUT, SITE FEATURES, AND DETAILS SHOWN ON FIGURES 1 THROUGH 4 ARE BASED ON FIELD SKETCHES AND ARE APPROXIMATE.

Revisions			
Symbol	Descriptions	Date	Approved

CDM Federal Programs Corporation

U.S. DEPARTMENT OF TRANSPORTATION
JOHN A. VOLPE NATIONAL
TRANSPORTATION SYSTEMS CENTER

US EPA
Region VIII
Helena, Montana

LIBBY ASBSESTOS PROJECT
LIBBY, MONTANA

FIGURE 1
OVERALL SITE LAYOUT
FORMER STIMSON CENTRAL
MAINTENANCE BUILDING

Designed by:	D. SPIELMAN
Drawn by:	A. RASSAS
Checked by:	G. MCKENZIE
Submitted by:	T. WALL
Scale:	AS NOTED
Date:	JUNE 2004
Dwg. No.:	
Sheet number:	–
Plot Scale:	1 : 1
Design File:	STIMSON_MAINT_BLDG_LAYOUT.DWG
File No.:	

INTERIOR REMOVAL PLAN NOTES:

(SEE CONTRACT DOCUMENTS FOR ADDITIONAL INFORMATION)

1. ALL WORK SHALL BE PERFORMED IN ACCORDANCE WITH ALL HEALTH AND SAFETY REQUIREMENTS, IN ADDITION TO THOSE SPECIFIED IN THE RESPONSE ACTION WORK PLAN ADDENDUM.

2. ALL WORK SHALL BE PERFORMED IN THE SEQUENCE SPECIFIED IN THE RESPONSE ACTION WORK PLAN ADDENDUM.

3. REMOVE ALL INSULATION FROM THE WALLS OF THE FORMER MOBILE SHOP, MIDLINE WALLS, EAST WALL OF ROOM 1-1, WEST WALL OF ROOM 17-2, AND WEST WALL OF ROOM 17-3.

4. THE CONTRACTOR SHALL INSPECT ALL VAULTS FOR VCI, AND SURFICIAL VACUUM VCI WITHIN VAULTS.

5. THE CONTRACTOR SHALL PERFORM INTERIOR CLEANING IN THE FORMER MOBILE SHOP.

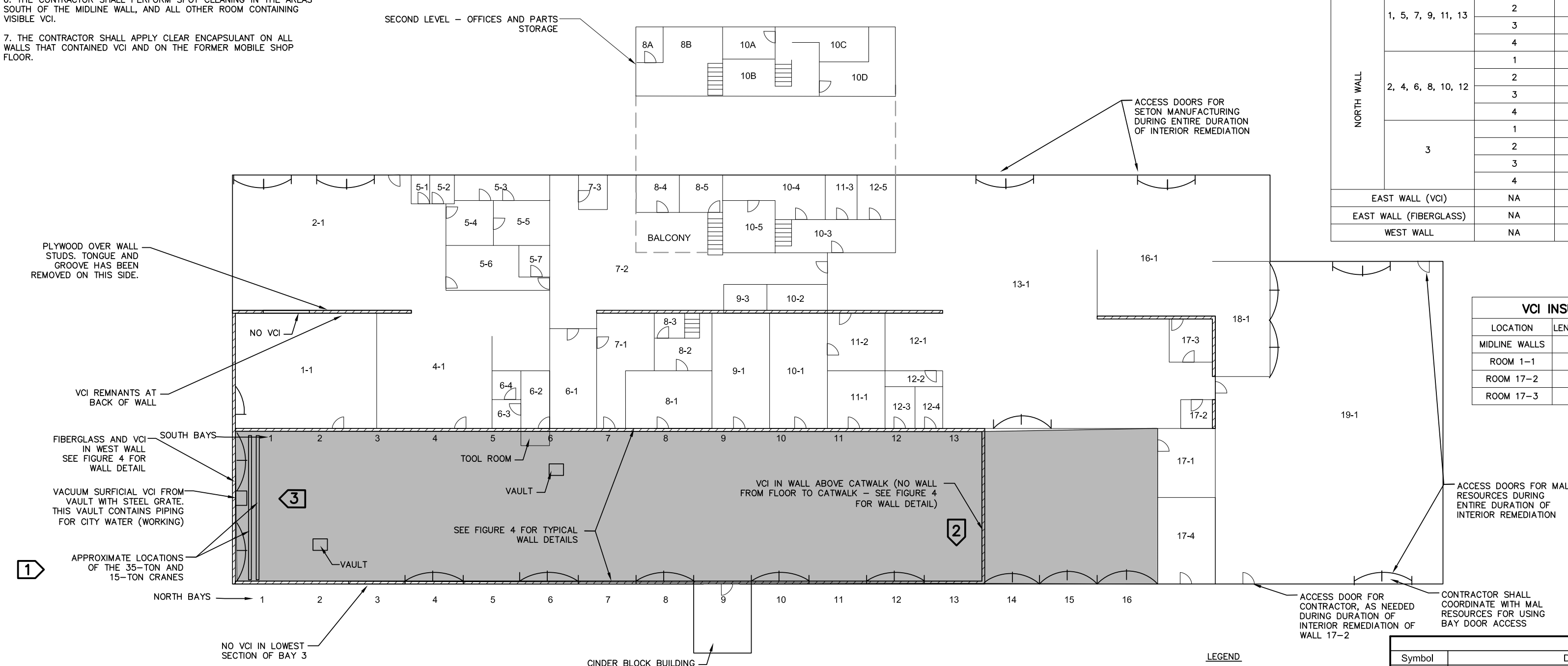
6. THE CONTRACTOR SHALL PERFORM SPOT CLEANING IN THE AREAS SOUTH OF THE MIDLINE WALL, AND ALL OTHER ROOM CONTAINING VISIBLE VCI.

7. THE CONTRACTOR SHALL APPLY CLEAR ENCAPSULANT ON ALL WALLS THAT CONTAINED VCI AND ON THE FORMER MOBILE SHOP FLOOR.

INTERIOR REMOVAL PLAN

PLAN VIEW

APPROXIMATE SCALE 0 20'



VCI INSULATION QUANTITIES – MOBILE SHOP

LOCATION	BAYS	SECTION	AREA (SF)	THICKNESS (IN)	# OF BAYS	VOLUME (CY)
SOUTH WALL	2, 3, 4, 5, 6, 8, 9, 10, 11, 12 ,13	1	380	0	–	–
		2	220	6	11	45
		3	300	6	11	61
	1	1	380	0	–	–
		2	110	6	1	2
		3	150	6	1	3
	7	1	380	0	–	–
		2	220	6	1	4
		3	150	6	1	3
NORTH WALL	1, 5, 7, 9, 11, 13	1	250	6	6	28
		2	240	6	6	27
		3	240	6	6	27
		4	120	6	6	13
	2, 4, 6, 8, 10, 12	1	320	0	–	–
		2	160	6	6	18
		3	240	6	6	26
		4	120	6	6	13
	3	1	250	0	–	–
		2	240	6	1	4
		3	240	6	1	4
		4	120	6	1	2
EAST WALL (VCI)		NA	1406	6	NA	27
EAST WALL (FIBERGLASS)		NA	224	6	NA	4
WEST WALL		NA	1350	6	NA	25

VCI INSULATION QUANTITIES – E&W AREAS

LOCATION	LENGTH (LF)	HEIGHT (FT)	THICKNESS (IN)	VOLUME (CY)
MIDLINE WALLS	195	15	6	54
ROOM 1–1	40	15	6	11
ROOM 17–2	10	15	6	3
ROOM 17–3	21	15	6	6

LEGEND

- BAY DOOR
- SINGLE DOOR
- VCI WALL INSULATION
- 11-1 ROOM NUMBER
- ROOM REQUIRES INTERIOR CLEANING

1 EXTERIOR - EAST SIDE OF BUILDING
NTS

2 INTERIOR BUILDING WALL
NTS

3 STEEL GRATE OVER VAULT
NTS

Revisions			
Symbol	Descriptions	Date	Approved

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U.S. DEPARTMENT OF TRANSPORTATION
JOHN A. VOLPE NATIONAL
TRANSPORTATION SYSTEMS CENTER

US EPA
Region VIII
Helena, Montana

LIBBY ASBSESTOS PROJECT
LIBBY, MONTANA

FIGURE 2
INTERIOR REMOVAL PLAN
FORMER STIMSON CENTRAL
MAINTENANCE BUILDING

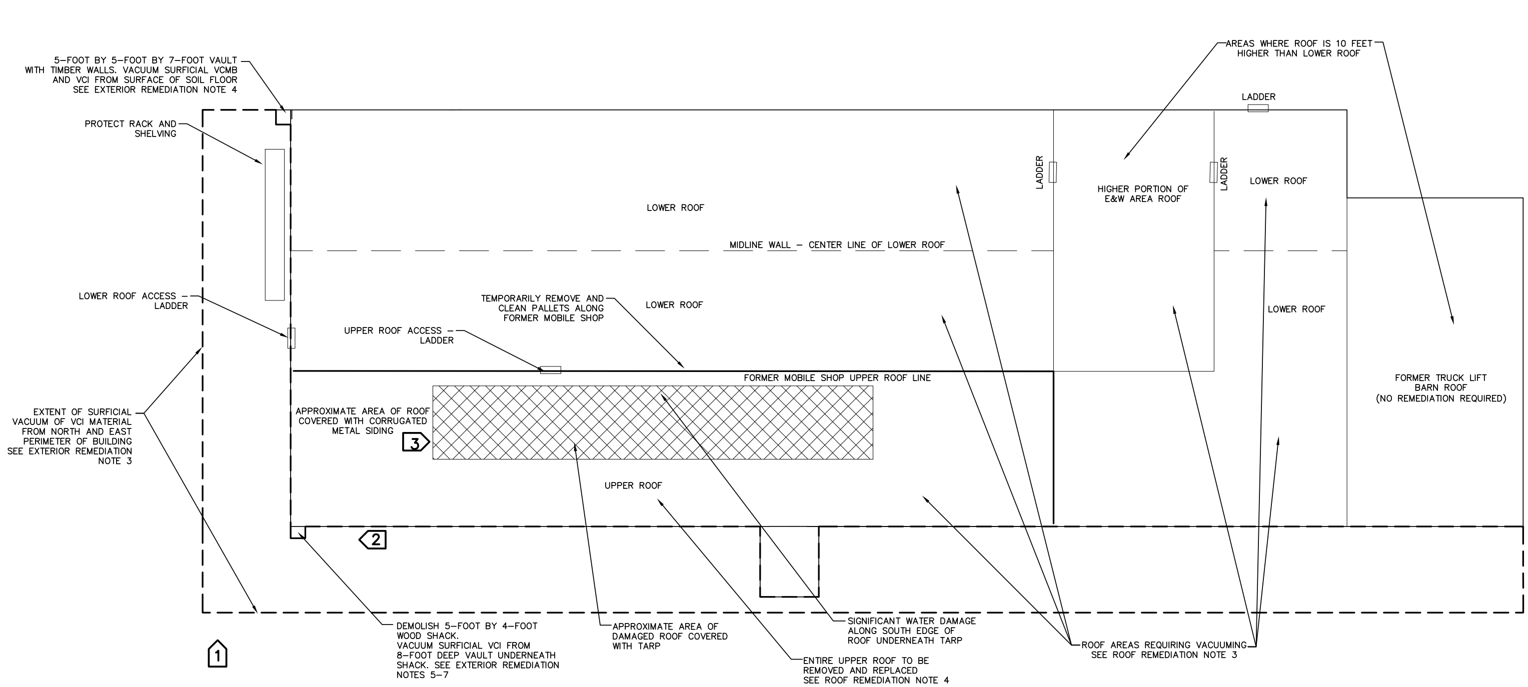
Designed by: D. SPIELMAN
Drawn by: A. RASSAS
Checked by: G. MCKENZIE
Submitted by: T. WALL

Scale: AS NOTED
Date: JUNE 2004
Dwg. No.:
Sheet number: –
Plot Scale: 1 : 1
Design File: STIMSON_MAINT_BLDG_INT_REM.DWG
File No.:

EXTERIOR REMOVAL PLAN

PLAN VIEW

APPROXIMATE SCALE
0 20'



ROOF REMEDIATION NOTES:

(SEE CONTRACT DOCUMENTS FOR ADDITIONAL INFORMATION)

1. ALL WORK SHALL BE PERFORMED IN ACCORDANCE WITH HEALTH AND SAFETY REQUIREMENTS, INCLUDING ANY ADDITIONAL REQUIREMENTS SPECIFIED IN THE RESPONSE ACTION WORK PLAN ADDENDUM.
2. ALL WORK SHALL BE PERFORMED IN THE SEQUENCE SPECIFIED IN THE RESPONSE ACTION WORK PLAN ADDENDUM.
3. THE CONTRACTOR SHALL VACUUM ALL SURFICIAL VCBM ON THE UPPER (FORMER MOBILE SHOP) ROOF, THE LOWER (FORMER ENGINEERING AND WAREHOUSE (E&W) AREA) ROOF, THE HIGHER ROOF IN THE FORMER E&W AREA, AND THE AREA WEST OF THE FORMER MOBILE SHOP. THE FORMER TRUCK LIFT BARN ROOF IS THE ONLY AREA NOT REQUIRING VACUUMING.
4. THE ENTIRE UPPER ROOF OF THE FORMER MOBILE SHOP WILL BE REMOVED AND REPLACED. SEE THE RESPONSE ACTION WORK PLAN ADDENDUM FOR DETAILS.
5. THE PALLETS LINING THE EDGE OF THE FORMER MOBILE SHOP ON THE LOWER ROOF WILL BE WASHED AND RETURNED TO THEIR ORIGINAL LOCATION.

EXTERIOR REMEDIATION NOTES:

(SEE CONTRACT DOCUMENTS FOR ADDITIONAL INFORMATION)

1. ALL WORK SHALL BE PERFORMED IN ACCORDANCE WITH HEALTH AND SAFETY REQUIREMENTS, INCLUDING ANY ADDITIONAL REQUIREMENTS SPECIFIED IN THE RESPONSE ACTION WORK PLAN ADDENDUM.
2. ALL WORK SHALL BE PERFORMED IN THE SEQUENCE SPECIFIED IN THE RESPONSE ACTION WORK PLAN ADDENDUM.
3. THE CONTRACTOR SHALL VACUUM ALL SURFICIAL VCBM AND VCI MATERIAL REMNANTS FROM THE EDGE OF THE EXTERIOR WALLS AND OUTWARD TO 30 FEET.
4. THE CONTRACTOR SHALL VACUUM ANY SURFICIAL VCBM OR VCI MATERIAL ON THE SURFACE OF THE SOIL FLOOR WITHIN THE SOUTHEAST VAULT. THE SOIL WITHIN THE VAULT DOES NOT REQUIRE REMEDIATION.
5. THE CONTRACTOR SHALL DEMOLISH THE SHACK LOCATED ALONG THE NORTHEAST BUILDING CORNER. ALL SUSPECT ACM INSULATION FROM THE PIPES INSIDE THE SHACK WILL BE REMOVED AND PROPERLY DISPOSED.
6. THE CONTRACTOR SHALL REMOVE ALL DEBRIS FOUND INSIDE THE NORTHEAST VAULT, VACUUM ALL SURFICIAL VCI INSIDE THE VAULT, AND APPLY ENCAPSULANT TO ALL WALLS AND FLOOR OF THE VAULT.
7. THE CONTRACTOR SHALL CONSTRUCT A COVER FOR THE NORTHEAST VAULT FOR SAFETY PURPOSES, CONSTRUCTED OF PLYWOOD AND 2–INCH BY 4–INCH FRAMING.

1 EXTERIOR - EAST SIDE OF BUILDING AND STORAGE SHELVING
NTS

2 WOOD SHACK OVER VAULT
NTS

3 DAMAGED AREA OF ROOF COVERED WITH TARP
NTS

1

Revisions			
Symbol	Descriptions	Date	Approved

CDM Federal Programs Corporation

U.S. DEPARTMENT OF TRANSPORTATION
JOHN A. VOLPE NATIONAL
TRANSPORTATION SYSTEMS CENTER

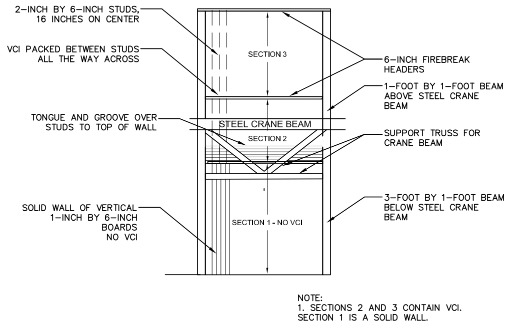
US EPA
Region VIII
Helena, Montana

LIBBY ASBSESTOS PROJECT
LIBBY, MONTANA

FIGURE 3
EXTERIOR REMOVAL PLAN
FORMER STIMSON CENTRAL
MAINTENANCE BUILDING

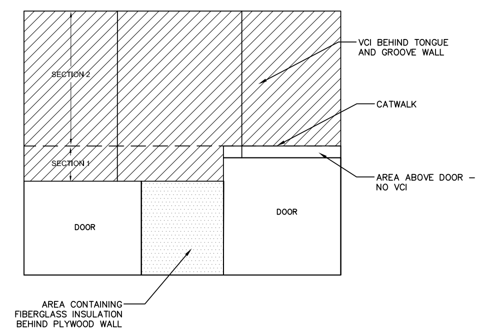
Designed by: D. SPIELMAN					
Drawn by: A. RASSAS					
Checked by: G. MCKENZIE	Scale:	AS NOTED	Sheet number:	Plot Scale:	1 : 1
Submitted by: T. WALL	Date:	JUNE 2004	–	Design File:	STIMSON_MAINT_BLDG_INT_REM.DWG
	Dwg. No.:			File No.:	

TYPICAL SOUTH WALL BAY DETAIL WITHOUT DOORS

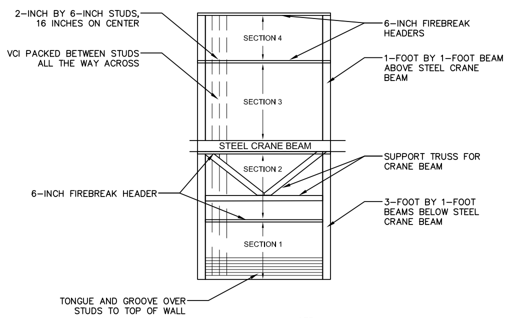


NOTE:
1. SECTIONS 2 AND 3 CONTAIN VCI. SECTION 1 IS A SOLID WALL.

EAST WALL DETAIL

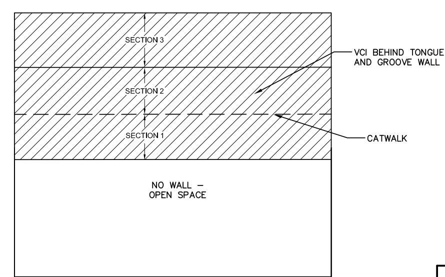


TYPICAL NORTH WALL BAY DETAIL WITHOUT DOORS



NOTE:
1. ALL FOUR SECTIONS CONTAIN VCI.

WEST WALL DETAIL



Revisions			
Symbol	Descriptions	Date	Approved

CDM Federal Programs Corporation

U.S. DEPARTMENT OF TRANSPORTATION
JOHN A. VOLPE NATIONAL
TRANSPORTATION SYSTEMS CENTER

US EPA
Region VIII
Helena, Montana

LIBBY ASBSESTOS PROJECT
LIBBY, MONTANA

FIGURE 4
FORMER MOBILE SHOP WALL DETAILS

Designed by: D. SPIELMAN
Drawn by: A. RASSAS
Checked by: G. MCKENZIE
Submitted by: T. WALL

Scale: AS NOTED
Date: MAY 2004
Dwg. No.:
Sheet number: –
Plot Scale: 1 : 1
Design File: STIMSON_MAINT_BLDG _DETAILS.DWG
File No.:

Appendix A3
Libby and Troy Creek Investigation
Summary Memo

CDM

Memorandum

To: *Mark Raney*

From: *C.Tyler Irwin, Nick Raines*

Date: *November 7, 2008*

Subject: *Summary of Creek Investigations Completed for Libby Asbestos Superfund Site Operable Units 4 and 7, October 2008*

1.0 Overview of Investigation

EPA tasked the US Department of Transportation, John A. Volpe National Transportation Systems Center (Volpe) with the investigation of several area creeks within Operable Unit 4 (OU4) in Libby, Montana and Operable Unit 7 (OU7) in Troy, Montana. The purpose of this investigation was to evaluate the presence or absence of suspect Libby Amphibole (LA) in material used for the construction of riprap in the creeks. The purpose and plan for the investigation are discussed in further detail within *Libby and Troy Creek Investigation Memo, October 2008.*

Granite Creek and Flower Creek in Libby and Callahan Creek in Troy were previously investigated in May 2008.The October 2008 investigations included Libby Creek (Cr), Parmenter Cr, Pipe Cr, Doak Cr, Bobtail Cr, Cedar Cr, and Quartz Cr in Libby (Figure 1), and Lake Cr, Iron Cr, and Brien Cr in Troy (Figure 2). All creeks are perennial streams and experience significant flow fluctuations during the spring and following heavy precipitation events. As a result, the creeks have had riprap placed at various sections by the US Army Corps of Engineers (USACE), Lincoln County, the City of Libby, and/or private land owners to control erosion. Each listed creek was investigated near overpasses, bridges, and along roadways, in residential backyards, and other populated areas. The estimated lengths of each investigated creek are listed below.

<u>Troy</u>

Lake Cr (Kootenai River Section)	1.1 miles
Lake Cr (Mid Section)	0.12 mile
Lake Cr (Overpass Section)	0.12 mile
Iron Cr	0.95 mile
Obrien Cr	0.2 mile

<u>Libby</u>

Libby Cr	6.7 miles
Libby Cr (Hammer Rd Section)	0.19 mile
Parmenter Cr	1.9 miles

Pipe Cr (Lower Section)	1 mile
Pipe Cr (Upper Section)	2 miles
Doak Cr	0.19 mile
Bobtail Cr	0.57 mile
Cedar Cr	0.6 mile
Quartz Cr	1.1 miles

Material used for the construction of riprap sections in the creeks included: 1) quarried argillite and siltstone (metasediments) from the Wallace Formation (Fm) of the Precambrian Belt Group, 2) quarried syenite from the Rainy Creek ultramafic complex, 3) basalt, and 4) concrete debris, tree stumps, wood lagging. The syenite is exposed at the Vermiculite Mountain Mine, and riprap constructed with this material is thought to have originated at the mine. LA material in the form of biotite pyroxenite, magnetite pyroxenite, and LA are often found in the presence of the syenite.

Results of the investigations are summarized in the sections below. Estimated volumes of individual sections that contain syenite and LA material are presented in Table 1.

2.0 Results of Creek Investigation Program

2.1 Introduction

Syenite and LA material were not identified in any of the Troy area creeks, and only in two Libby area creeks during the October 2008 investigation. A description of the occurrence of syenite and LA material in the Libby area creeks follows.

2.2 Pipe Creek (Lower Section)

A 1-mile section of Pipe Cr, beginning at the Kootenai River, was investigated on October 13, 2008 (Figure 1). Riprap material in this section of Pipe Cr is composed of metasediments and basalt except for riprap located at two residential properties on the northern bank of Pipe Cr, between Kootenai River Rd and Botham Drive (Figure 3).

Riprap located on both of these properties is composed of quarried syenite and a smaller volume of metasediments ranging in size from cobbles to boulders. The largest pieces of syenite are approximately 3 feet (ft) in length, averaging approximately 18 inches (in). The syenite locally contains LA material as fracture coatings on syenite. The fracture coatings are the most prevalent form and appear as small radiating, fibrous aggregates, light blue-gray to dull silver in color, similar to LA material observed in Libby Cr.

The riprap at 3623 Kootenai River Rd (PC-01 to PC-02) was placed in a curved, linear exposure (10 ft in total lateral extent) and is approximately 200 ft in length. The riprap at 3737 Kootenai River Rd (PC-03 to PC-04) has similar placement and is approximately 300 ft in length. The riprap at both locations is weathered and often discontinuous with indications of downstream mobilization of components due to erosion.

The locations of these two sections were surveyed with a Trimble GPS unit.

Field sketches of cross–sections of these two locations were not created due to the inconsistent and discontinuous distribution of the material. Further survey activities may be required to fully detail the physical layout of these sections of rip-rap.

2.3 Libby Creek

A 6.7-mile section of Libby Cr, extending from the Kootenai River to near Farm to Market Road (F-M Rd) on the south end of the section was investigated on October 9, October 10, and October 20, 2008 (Figure 1). All riprap material in this section of Libby Cr is composed of metasediments, basalt, and concrete debris, except for a small exposure of riprap located on the eastern bank of the creek, approximately 700 ft south of the Champion Haul Rd bridge (Figure 4).

This riprap section (LC-01 to LC-02) is composed of quarried syenite. The largest pieces are approximately 3 ft in length, averaging approximately 18 in. The syenite locally contains weathered xenoliths of magnetite pyroxenite and biotite pyroxenite. LA material is present in this riprap, and occurs most commonly as fracture coatings on syenite. The fracture coatings appear as small radiating, fibrous aggregates that are light blue-gray to dull silver in color. The LA is soft and has been weathered.

The riprap at this section was placed in a linear exposure (15 ft in lateral extent) and is approximately 300 ft in length. This riprap was deposited in layers. The bottom of the syenite layer (approximately 5 ft height) occurs near the water line and is covered by a 5-ft layer of basalt. The riprap is consolidated with no obvious indication of downstream mobilization of large components due to erosion.

The location of this section was surveyed with a Trimble global positioning system (GPS) unit.

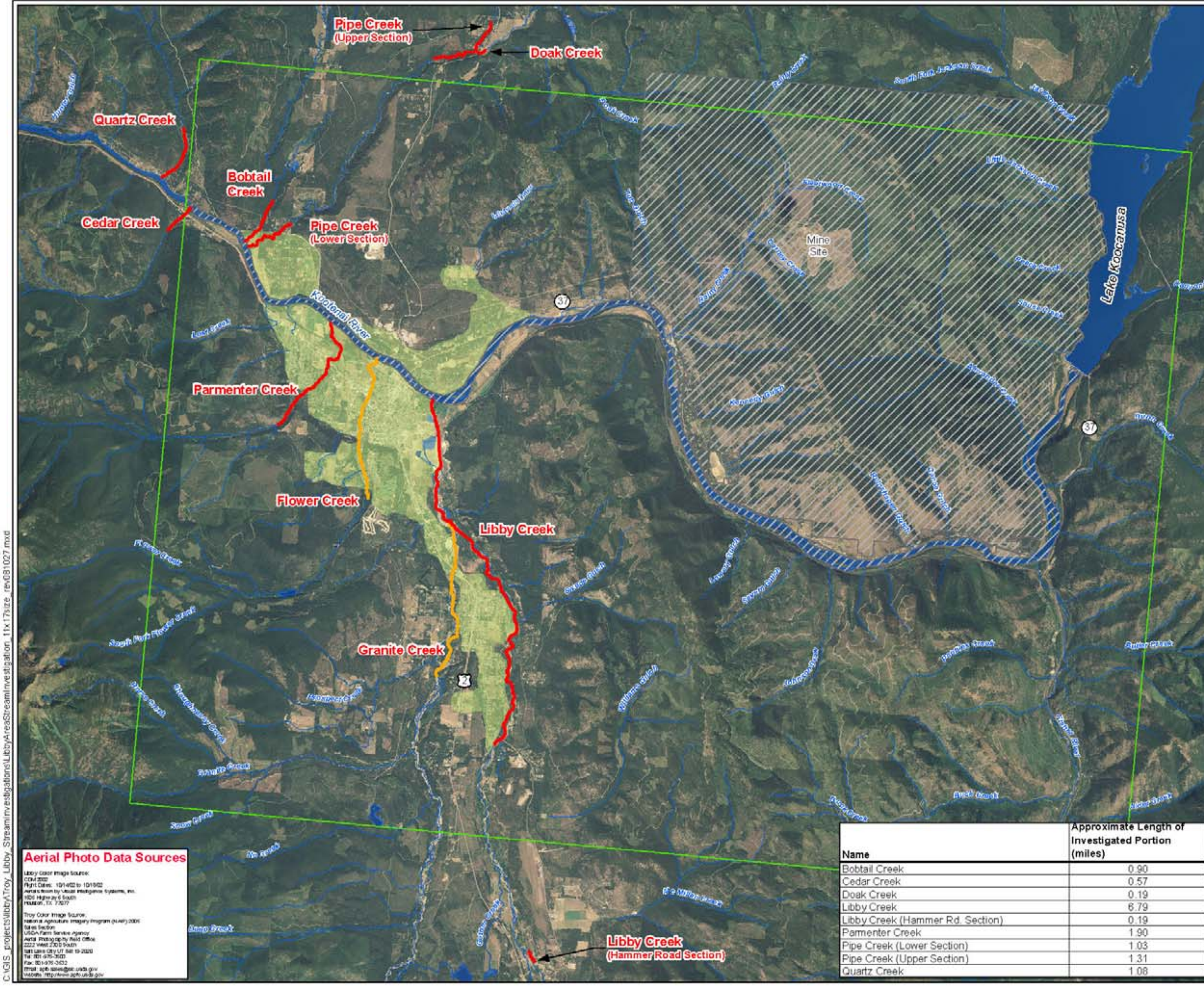
A field sketch of the cross–section at this location was created in the field log notes and is available upon request. Further survey activities may be required to fully detail the physical layout of these sections of rip-rap.

3.0 Summary

Several creeks in the Libby and Troy areas were investigated to evaluate the presence and extent of LA material used for the construction of riprap. Riprap material at one section of Libby Cr and two sections of Pipe Cr includes quarried syenite, which is thought to have originated at the Vermiculate Mountain Mine. The syenite contains LA in the form of weathered fracture coatings. The three occurrences of syenite and LA material are listed below with location designations and estimated volumes.

Table 1 – Summary of Estimated Volumes of Riprap containing LA		
CREEK	STATION	VOLUME (bank cubic yards)
Libby Creek	LC-01 to LC-02	1,000*
Pipe Creek	PC-01 to PC-02	200
	PC-03 to PC-04	200

*Not including overlying basalt



Aerial Photo Data Sources

Libby Color Image Source:

Troy Color Image Source:

USDA Farm Service Agency

Name	Approximate Length of Investigated Portion (miles)
Bobtail Creek	0.90
Cedar Creek	0.57
Doak Creek	0.19
Libby Creek	6.79
Libby Creek (Hammer Rd. Section)	0.19
Parmenter Creek	1.90
Pipe Creek (Lower Section)	1.03
Pipe Creek (Upper Section)	1.31
Quartz Creek	1.08

Creeks/Rivers
Portion of Creek Investigated
Portion of Creek Investigated Previously
OU4 Boundary
OU3 Boundary
Lake
Populated Areas

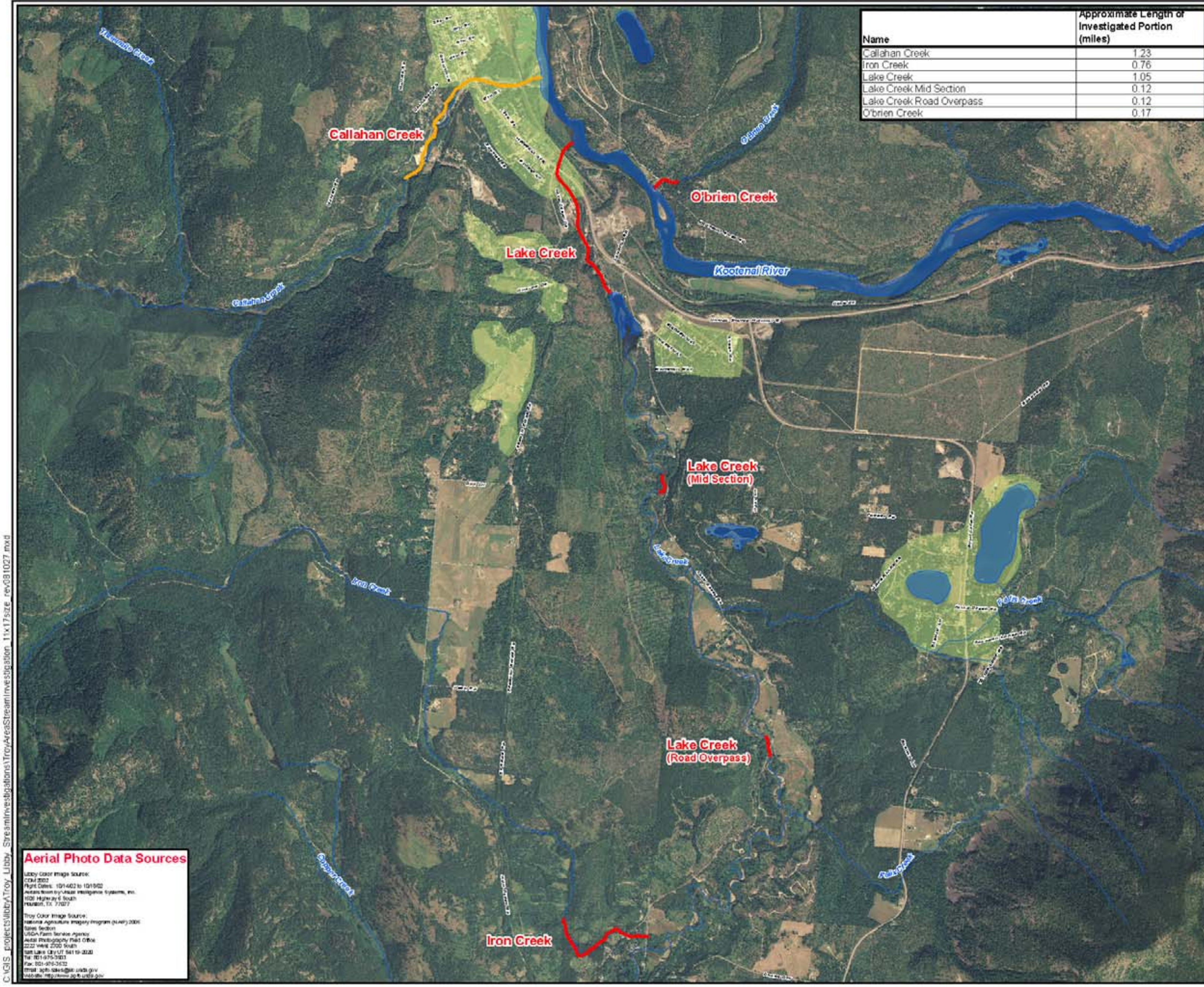
Miles
0 1 2 4
1 inch equals 1.5 miles

DRAFT - For Official Use Only

Figure 1

OU4 Creek Investigations
Libby Asbestos Site
Libby, Montana

CDM



Name	Approximate Length of Investigated Portion (miles)
Callahan Creek	1.23
Iron Creek	0.76
Lake Creek	1.05
Lake Creek Mid Section	0.12
Lake Creek Road Overpass	0.12
O'brien Creek	0.17

Aerial Photo Data Sources

Libby Color Image Source:
CDM 2002
Flight Dates: 10/14/02 to 10/15/02
Aerials flown by Visual Intelligence Systems, Inc.
1026 Highway 6 South
Houston, TX 77077

Troy Color Image Source:
National Agriculture Imagery Program (NAIP) 2006
Sales Section
USDA Farm Service Agency
Aerial Photography Field Office
2222 West 2300 South
Salt Lake City UT 84119-2020
Tel: 801-975-3503
Fax: 801-975-3532
Email: apfo.sales@slc.usda.gov
Website: http://www.apfo.usda.gov

Creeks/Rivers
Portion of Creek Investigated
Portion of Creek Investigated Previously
Lake
Populated Areas

N W E S

Miles
0 0.25 0.5 1 1.5
1 inch equals 3,000 feet

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Figure 2

Troy Area Creek Investigations
Libby Asbestos Site
Libby, Montana

CDM

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Areas Requiring Remedial Action

Portion of Creek Investigated

N W E S

Feet

0 50 100 200 300

1 inch equals 125 feet

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Figure 3

Pipe Creek (Lower Section)
Remediation Areas
Libby Asbestos Site
Libby, Montana

CDM

C:\GIS_projects\libby\Troy_Libby_StreamInvestigations\PipeCreekLower_RemSites_11x17size_rev081027.mxd

Area Requiring Remedial Action

Portion of Creek Investigated

N
W E
S

Feet

0 50 100 200 300

1 inch equals 125 feet

DRAFT - For Official Use Only

Figure 4

Libby Creek
Remediation Areas
Libby Asbestos Site
Libby, Montana

CDM

C:\GIS_projects\libby\Troy_Libby_StreamInvestigations\LibbyCreek_RemSites_11x17size_rev081027.mxd

Form Numb AD-005414

LIBBY ASBESTOS PROJECT
Property Closeout Checklist (PCC)
Revision 3

Form Date: 8-3-09

Field Logbook No.: 101121 / 101103 Page No.'s: 19, 15, 4 / 8

Address: Libby Creek City: Libby

Occupant: NA

Owner: State of Montana

Oversight Personnel: K. Beaudoin, S. McNally

Removal Contractor: ER

Restoration Contractor: ER

Associated BD Numbers: NA

PCC Check Completed by (100% of forms): [illegible signature] Date: 10/21/09

Data Item	Value		Comments
Type of removal activity *circle all that apply*	VCI removal Interior cleaning Exterior removal Building materials Other: Riprap		*Circle all that apply:* Quick Response | Partial Removal
	Start	Finish	
Interior setup date(s)	NA	NA	*NA implies interior work not needed*
Interior removal date(s)	NA	NA	*NA implies interior work not needed*
Interior restoration date(s)	NA	NA KLB ~~8-12-09~~ 8-19-09	*NA implies interior work not needed*
Exterior setup date(s)	8-3-09	8-4-09	*NA implies exterior work not needed*
Exterior removal date(s)	8-4-09	8-25-09	*NA implies exterior work not needed*
Exterior restoration date(s)	8-13-09	~~8-13-09~~ KLB 8-20-09 ~~9-10-09~~	*NA implies exterior work not needed* 09/03/09 h 10/7/09
Total days at property [include weekends]	~~39~~ 32 h 10/7/09		
Contaminated material removed *circle all that apply*	Soil VCI Other insulation Household items Rubbish/Debris Other: RipRap		

C:\Documents and Settings\beaudoinkr\Desktop\PCC.doc

Data Item	Value	Comments
Cubic yards (Yd^3) of contaminated material removed:		
Soil	499 Yd^3 NA	
VCI	______ Yd^3 NA	
Other insulation	______ Yd^3 NA	Type of insulation removed:
Household items	Description: NA	
Rubbish/Debris	95 Truckloads NA	Description: RipRap
Any contaminated material remaining after removal is complete? *[responses must be consistent within the shaded sections]*	No *- circle if next two items are circled NA below* Soil *- circle if Contaminated soil remaining is circled below* VCI *- circle if VCI remaining is circled below*	
[responses must be consistent within the shaded sections] Contaminated soil remaining NA *[When revising this section also revise corresponding item in shaded section above]*	Location description: Areas A2, A3, & A1, ~~& A4~~ mgR 10/21/09 had <1% Libby amphibol at 12-14" BGS Areas ~~D1,~~ mgR 10/21/09 A1, B1, A2, A3, B2 had visible vermiculite at 12" BGS Area A5 had visible vermiculite at 48-74" BGS	
[responses must be consistent within the shaded sections] VCI remaining NA *[When revising this section also revise corresponding item in shaded section above]*	Location description: [include RAWP Addendum background information]	

C:\Documents and Settings\beaudoinkr\Desktop\PCC.doc

Data Item	Value	Comments

Cubic yards (Yd^3) of material replaced:

Insulation	______ Yd^3 NA	Type:
Residential fill	244 Yd^3 NA	
Topsoil	______ Yd^3 NA	
Other material (i.e., gravel)	(a) 237, (b) (137) Yd^3 (C) 1000 NA	Type: (a) 3/4" minus crushed Rock (b) 2" minus crushed Rock (C) Riprap
HEPA vacuum given to resident?	Date: ______ Not given	Reason:
Items damaged during construction	☐ See removal and restoration checklist ☑ None	

ADDITIONAL INFORMATION

One Amendment TWO Mods

CDM

CLIENT
PROJECT
DETAIL
JOB NO.
DATE CHECKED
CHECKED BY
COMPUTED BY
DATE
PAGE NO.

LIBBY CREEK
MONTANA

2R- 07083
SP- 141276
AREA C, B3
12-14"
ND
NO VISIBLE

2R- 07084
SP- 141277
AREA B2
12-14"
ND
visible (1 low)

2R- 07087
SP- 141278
AREA B1
12-14"
ND
visible observed
(1 low)

2R- 07126
SP- 141293
AREA D1
12-14"
ND
resampled as Area D2

2R- 07133
SP- 141300
AREA A2
12-14"
<1%
visible observed
(7 low)

2R- 07134
SP- 141301
AREA A3
12-14"
<1%
visible observed
(6 low)

CDM

CLIENT ______ JOB NO. ______ AD-005414 COMPUTED BY ______
PROJECT ______ DATE CHECKED ______ DATE ______
DETAIL ______ CHECKED BY ______ PAGE NO. ______

2R- 07509 > AREA A1 12-14" BGS — <1% — LIBBY CREEK MONTANA

SP- 141305 — 2 low visible

2R- 07510 > AREA A4 12-14" BGS — ~~<1%~~ ND mjl 10/21/09

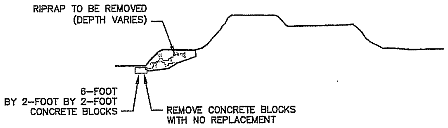
SP- 141306 — no visible

2R- 07273 > Area A5, D2 48"-74" — ND

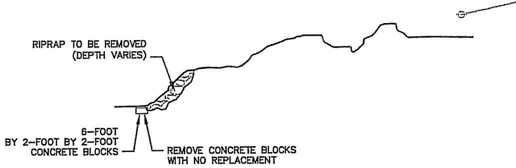
SP- 140813 — 1 Low visible

AD-005414

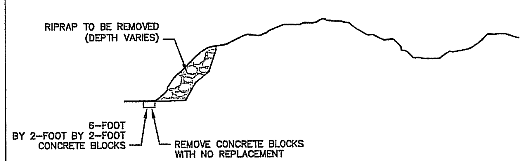
5	4	3	2	1



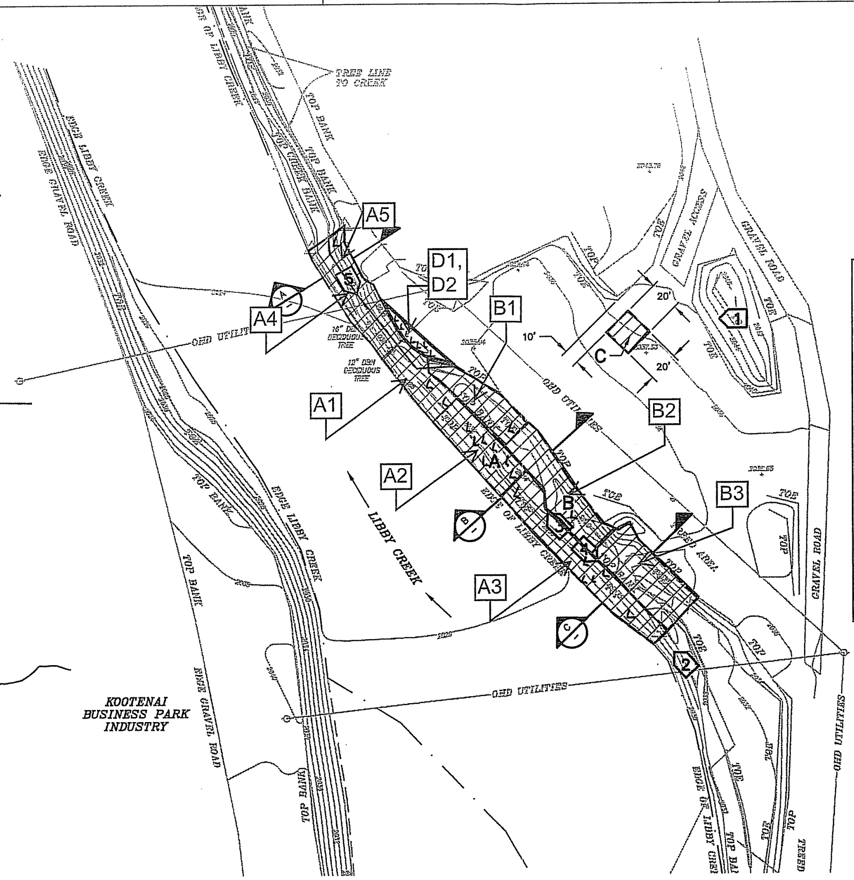
SECTION A
NTS



SECTION B
NTS



SECTION C
NTS



Soil Samples:
B1
B2
B3, C
D1
A1
A2
A3
A4
A5 48-74" bgs
D2 48-74" bgs

All other samples are12-14" bgs

SCALE IN FEET
20 0 40

EXTERIOR REMEDIATION NOTES:
(REFER TO CONTRACT DOCUMENTS FOR ADDITIONAL INFORMATION)

1. THIS PROPERTY HAS BEEN INSPECTED USING STANDARD OPERATING PROCEDURE CDM LIBBY-06.
2. THE REMOVAL CONTRACTOR SHALL PERFORM THE WORK WHILE MINIMIZING ENVIRONMENTAL POLLUTION AND DAMAGE AS THE RESULT OF CONSTRUCTION OPERATIONS. THE ENVIRONMENTAL RESOURCES WITHIN THE PROJECT BOUNDARIES AND THOSE AFFECTED OUTSIDE THE CONSTRUCTION LIMITS SHALL BE PROTECTED DURING THE ENTIRE DURATION OF THIS PROJECT.
3. THE REMOVAL CONTRACTOR SHALL PLACE SAND BAGS WITHIN THE CREEK BED UPSTREAM OF EXCAVATION AREAS ADJACENT TO FLOWING WATER TO MINIMIZE FLOW AND LOCALIZE SEDIMENT TRANSPORTATION.
4. THE REMOVAL CONTRACTOR SHALL PROVIDE THE WATER SOURCE FOR PERSONNEL AND EQUIPMENT DECONTAMINATION. DECONTAMINATION WATER WILL BE CAPTURED AND DISPOSED OF PROPERLY.
5. REMOVE ALL RIPRAP FROM THE CREEK BANK (AREA A) IN ADDITION TO 12 INCHES BELOW GROUND SURFACE.

BEST MANAGEMENT PRACTICE NOTES:

1. APPROPRIATE EROSION AND SEDIMENT CONTROLS (SILT FENCES, TEMPORARY WATER RETENTION BERMS, ETC.)SHALL BE INSTALLED PRIOR TO THE COMMENCEMENT OF WORK AND SHALL BE MAINTAINED FOR THE DURATION OF REMOVAL ACTIVITIES.
2. EQUIPMENT SHALL BE PRESSURE WASHED PRIOR TO SITE ENTRY TO PREVENT THE SPREAD OF NOXIOUS WEEDS TO THE REMOVAL AREA.
3. EQUIPMENT USED NEAR THE WATER SHALL BE CLEANED PRIOR TO CONSTRUCTION.
4. WORK SHALL BE CONDUCTED DURING A PERIOD OF LOW FLOW.
5. BIODEGRADABLE HYDRAULIC FLUIDS SHALL BE USED IN MACHINERY WHERE APPROPRIATE.
6. REFUELING SHALL OCCUR ON THE BACKSIDE OF THE LEVEE OR ON ESTABLISHED STAGING AREAS.
7. CONSTRUCTION EQUIPMENT SHALL BE REGULARLY CHECKED FOR DRIPS OR LEAKS.
8. AT LEAST ONE FUEL SPILL KIT WITH ABSORBENT PADS SHALL BE ONSITE AT ALL TIMES.
9. DRIVE TRAINS OF EQUIPMENT SHALL NOT OPERATE IN THE WATER.

12" BGS EXCAVATION DEPTH

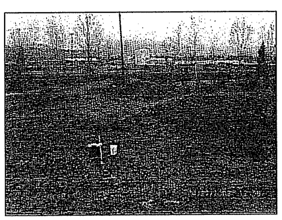
EXCAVATION QUANTITIES

AREA DESIGNATION	AREA (ft^2)	DEPTH (in.)	IN-PLACE VOLUME (yd^3)
A	7379	12	273
B	5405	12	200
C	400	12	15
RIPRAP	–	–	1000*
		TOTAL	1488*

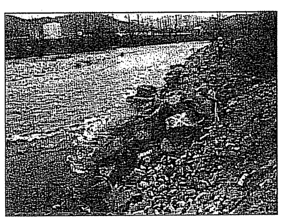
* RIPRAP VOLUME IS ESTIMATED BASED ON FIELD MEASUREMENTS AND VISUAL OBSERVATIONS.

NOTE: REFER TO SHEET C-1 FOR GENERAL NOTES, LEGENDS, MAPS AND OTHER INFORMATION. REFER TO SHEET C-2 FOR DETAILS.

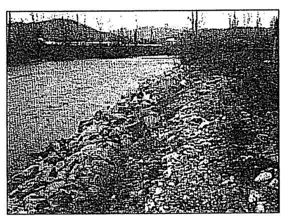
Revisions			
Symbol	Descriptions	Date	Approved



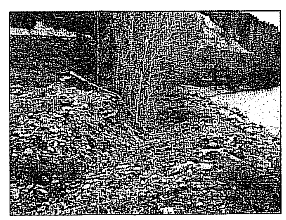
1 SITE ACCESS AND EXCAVATION AREA C



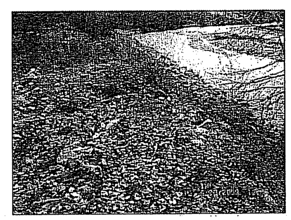
2 SOUTHERN EXTENT OF RIPRAP LOOKING DOWNSTREAM



3 CENTER OF RIPRAP AREA LOOKING DOWNSTREAM



4 SOUTHERN PORTION OF RIPRAP LOOKING UPSTREAM



5 NORTHERN PORTION OF RIPRAP LOOKING UPSTREAM

CDM Federal Programs Corporation

U.S. DEPARTMENT OF TRANSPORTATION
JOHN A. VOLPE NATIONAL TRANSPORTATION SYSTEMS CENTER

Designed by: N. L. SMITH	US EPA Region VIII Denver, Colorado — LIBBY ASBESTOS PROJECT LIBBY, MONTANA
Drawn by: M. KUZMIAK	LIBBY CREEK REMEDIATION PLAN
Checked by: G. McKENZIE	Scale: AS NOTED · Sheet number: · Plot Scale: 1 : 1
Submitted by: T. WALL	Date: JUNE 5, 2009 · Design File: LIBBY_CREEK.DWG · Dwg. No.: · File No.:

5	4	3	2	1

Page 6 of 6

Appendix B
Sample Phase List

Phase 1

202 field samples (analyzed by TEM-AHERA)
196 stationary indoor, 4 stationary outdoor, 2 personal outdoor
Index ID range 1-08051 to 1-09014
Sample Date range 6/23/2004 to 8/13/2009
Only 1/202 samples were detect for LA
    1-08592: total LA conc = 0.0046 s/cc

Phase 1R

232 field samples (analyzed by TEM-AHERA)
160 stationary indoor, 53 stationary outdoor, 19 personal indoor
Index ID range 1R-24496 to 1R-36895
Sample Date range 1/23/2004 to 6/29/2006
10/232 samples were detect for LA (20 samples w/o TEM results)
    Total LA conc detects range: 0.0048 s/cc to 1.4 s/cc
    Highest detects were personal air samples during bulk removal
    All detects measured in May-June 2005

Phase 2R

21 field samples (analyzed by TEM-AHERA)
16 stationary indoor, 5 stationary outdoor
Index ID range 2R-01028 to 2R-05369
Sample Date range 5/22/2008 to 5/21/2009
5/21 samples were detect for LA (5 samples w/o TEM results)
    Total LA conc detects range: 0.0048 s/cc to 0.42 s/cc
    All detects measured April 28, 2009 from soil split connex

Ambient Air Program (AA)

40 field samples (analyzed by TEM-ISO)
all stationary outdoor [from one OU5 monitor]
Index ID range AA-00081 to AA-01721
Sample Date range 10/4/2006 to 9/21/2007
8/40 samples were detect for LA (1 sample w/o TEM results)
    Total LA conc detects range: 3.6E-05 s/cc to 1.6E-04 s/cc

SQAPP ABS Sampling Program (SQ)
20 field samples (analyzed by TEM-ISO)
12 stationary outdoor, 8 personal outdoor [3 activities * 2 ABS areas]
Index ID range SQ-00041 to SQ-00134
Sample Dates 6/21/2005 (ND ABS area), 6/25/2005 (Tr ABS area)
6/20 samples were detect for LA
Total LA conc detects range: 9.6E-04 s/cc to 0.0010 s/cc

Stimson Lumber Programs (SL)
456 field samples (analyzed by TEM-ISO, +AHERA for some)
103 stationary indoor, 150 personal indoor, 20 stationary outdoor, 183 personal outdoor
Index ID range SL-00001 to SL-70815
Sample Date range 9/10/2002 to 9/18/02 and 10/10/07 to 10/2/2008
111/456 samples were detect for LA (1 sample w/o TEM results)
Total LA conc detects range: 3.8E-04 s/cc to 0.16 s/cc

Index ID Summary:
SL-00001 to SL-00245 (not sequential):
monitoring of Stimson Lumber site workers (9/10/02 to 9/18/02)
N = 124 personal samples analyzed by ISO and AHERA
N = 38 stationary samples analyzed by ISO and AHERA
SL-00300 to SL-00339, SL-00420 to SL-00422: **MotoX ABS**
N = 24 personal samples analyzed by ISO (9/10/08 and 9/17/08)
N = 10 stationary samples analyzed by ISO (9/10/08 and 9/17/08)
SL-00340 to SL-00407: **RecVis Biking ABS**
N = 46 samples analyzed by ISO (9/16/08 to 9/19/08)
SL-00408 to SL-00418, SL-00424 to SL-00601: **Outdoor Worker ABS**
N = 48 samples analyzed by ISO (9/23/08 to 10/2/08)
SL-70120 to SL-70258 (not sequential): **Wood Chip/Waste Bark ABS**
N = 16 personal samples analyzed by ISO (10/10/07 to 10/15/07)
SL-70366 to SL-70393, SL-70540 to SL-70664 (not sequential): **Indoor Worker ABS, Stationary**
N = 75 samples analyzed by ISO (12/10/07 to 1/14/08)
SL-70404 to SL-70489, SL-70681 to SL-70687 (not sequential): **Indoor Worker ABS, Personal**
N = 38 samples analyzed by ISO (11/13/07 to 12/16/07)
SL-70672 to SL-70677, SL-70702 to SL-70815 (not sequential):
general worker monitoring during soil sample collection (6/25/08 to 7/14/08)
N = 37 samples analyzed by ISO

***ABS programs are shown in **blue**

<u>Oct 2002 Contaminant Screening Study (CS-)</u>
131 field samples (analyzed by PLM-VE)
105 surface, 26 subsurface (mostly 5-pt composites)
Index ID range: CS-08295 to CS-09672
Sample Date range: 10/14/2002 to 10/18/2002
Only 3/131 samples were detect for LA:

CS-09294	Tr	Southeast Area (0-6")
CS-09595	Tr	Nursery (0-6")
CS-09658	<1	Former Popping Plant (48-60")

All samples were Vis - *(Note: visible status not in Database)*

<u>May 2004 Bike Track Sampling (CS-)</u>
21 field samples (analyzed by PLM-VE)
8 (0-1"), 11 (2-6"), 2 (6-12") (mostly 5-pt composites)
Index ID range: CS-18433 to CS-18498
Sample Date: 5/15/2004
All samples were non-detect for LA
4/21 samples were Vis +

<u>May 2004 Pre-Design, Central Maintenance Bldg (1D-)</u>
4 field samples (analyzed by PLM-VE)
4 (0-1" 5-pt composites)
Index ID range: 1D-01823 to 1D-01826
Sample Date: 5/12/2004
All samples were non-detect for LA
2/4 samples were Vis +

<u>July 2004 Demolition Derby Sampling (CS-)</u>
19 field samples (analyzed by PLM-VE)
9 (0-1"), 9 (2-6"), 1 (6-12") (5-pt composites)
Index ID range: CS-18581 to CS-18599
Sample Date: 7/1/2004
Only 1/19 samples were detect for LA:

CS-18583	Tr	Grid 2 (0-1")

All samples were Vis - *(Note: visible status not in DB)*

<u>June 2005 SQAPP ABS (SQ-)</u>
4 field samples (analyzed by PLM-VE)
4 (0-2") (3-pt to 19-pt composites)
Index ID range: SQ-00061, SQ-00062, SQ-00066, SQ-00067
Sample Dates: 6/21/2005 and 6/25/2005
Only 2/4 samples were detect for LA:

SQ-00066	Tr	Lawn mowing scenario location
SQ-00067	Tr	Raking & child play scenario location

Both Trace samples were Vis +

<u>Oct 2007 Soil Data Gap Study (SL-)</u>

182 field samples (analyzed by PLM-VE)
180 (0-3" 30-pt composites), 2 (0-12" grabs from beneath piles)
- Libby GW Superfund Site, N = 90
- Former Nursery Area, N = 11
- Waste Bark Piles, N = 2
- Libby Creek Banks, N = 21
- Stormwater Containment/Waste Water Lagoon, N = 52
- Former North Guard Station, N = 1
- Diesel Pump House, N = 1
- Soil Sample Location CS-09294, N = 4

Index ID range: SL-70001 to SL-70343
Sample Date range: 10/2/2007 to 10/26/2007
7/182 samples were detect for LA:

SL-70038	Tr	SCWWL
SL-70053	Tr	SCWWL
SL-70072	1	Former nursery area
SL-70073	Tr	Former nursery area
SL-70074	Tr	Former nursery area
SL-70077	Tr	Former nursery area
SL-70110	Tr	Libby Groundwater Superfund Site

Visible status reported as n-X, n-L, n-M, n-H in DB
and summarized in CDM report figures

<u>June/July 2008 Soil Data Gap Addendum (SL-)</u>

73 field samples (analyzed by PLM-VE)
73 (0-6" 30-pt composites)
- MotoX Track, N = 18
- Lumber Yard, N = 16
- Southwest Area, N = 16
- Railroad Spur, N = 1
- Log Storage Area, N = 20
- Former Popping Plant, N = 0

Index ID range: SL-70700 to SL-70819
Sample Date range: 6/25/2008 to 7/11/2008
30/73 samples were detect for LA:
- Tr: N=29 samples
- <1%: N=1 sample (Former Nursery)

Visible status reported as n-X, n-L, n-M, n-H in DB

<u>Oct 2008 Outdoor ABS (SL-)</u>

MotoX ABS

62 field samples
1 (0-3" 30-pt composites), 30 (0-3" grabs)
1 (0-6" 30-pt composites), 30 (0-6" grabs)
Index ID range: SL-01054 to SL-01387
Sample Date range: 10/16/2008 and 10/21/2008
2/62 analyzed by PLM-VE (composites only)
Both samples were non-detect for LA
Visible status reported as n-X, n-L, n-M, n-H in DB

Worker ABS

744 field samples [8 areas * 3 sampling rounds]
24 (0-3" 30-pt composites), 720 (0-3" grabs)
Index ID range: SL-00439 to SL-01633
Sample Date range:10/7/2008 to 10/24/2008
463/744 analyzed by PLM-VE
10/463 samples were detect for LA:
- 8 samples: Tr (Former Nursery)
- 1 sample: <1% (Former Nursery)
- 1 sample: Tr (SW Area)

Visible status reported as n-X, n-L, n-M, n-H in DB

<u>Oct 2008 Landfarm (SL-)</u>

51 field samples (analyzed by PLM-VE)
51 subsurface (12-15" grabs)
Index ID range: SL-00900 to SL-00953
Sample Date: 10/14/2008
All samples were non-detect for LA
Visible status reported as n-X, n-L, n-M, n-H in DB

<u>April 2009 Re-Development Sampling (SL-)</u>

8 field samples (analyzed by PLM-VE)
8 (0-6" 30-pt composites)
Collected from 8 zones
Index ID range: SL-01760 to SL-01767
Sample Date: 4/21/09
All samples were non-detect for LA
All samples were Vis -

<u>April 2009 Pre-Design Libby Creek Driveway (1D-)</u>

7 field samples (analyzed by PLM-VE)
7 (0-3" to 0-6" 30-pt composites)
Index ID range: 1D-12501 to 1D-12507
Sample Date: 4/27/2009
All samples were non-detect for LA
All samples were Vis -

<u>May 2002, Phase 1</u>

2 field samples (analyzed by TEM-ISO)
collected from former nursery shed
Index IDs: 1-06850 and 1-06857
Sample Date 5/2/2002

1-06850: total LA conc = ND

1-06857: total LA conc = 7,026 s/cm^2

<u>Sept 2002 Contaminant Screening Study (SL-)</u>

37 field samples (analyzed by TEM-ISO)
collected from all site bldgs
Index ID range SL-00059 to SL-00242
Sample Date range 9/12/2002 to 9/18/2002
18/37 samples were detect for LA

Total LA conc detects range: 131 s/cm^2 to 44,116 s/cm^2

Exceedances of 5,000 s/cm^2:

SL-00061	8,823	Center of central main. bldg
SL-00175	8,823	Diesel fire pump house
SL-00178	44,116	Guard station at Libby Creek bridge

<u>April 2004 Pre-Design, Central Maintenance Bldg (1D-)</u>

24 field samples (analyzed by TEM-AHERA)
collected from central maintenance bldg
Index ID range 1D-01715 to 1D-01791
Sample Date range 4/19/2004 to 4/30/2004
5/24 samples were detect for LA

Total LA conc detects range: 483 s/cm^2 to 1,449 s/cm^2

<u>Nov/Dec 2007 Indoor Worker ABS (SL-)</u>

24 field samples (analyzed by TEM-ISO)
collected from all ABS bldgs
Index ID range SL-70400 to SL-70497
Sample Date range 11/13/2007 to 12/16/2007
4/24 samples were detect for LA

Total LA conc detects range: 35 s/cm^2 to 185 s/cm^2

***ABS programs are shown in **blue**

<u>April 2004 Central Maintenance Bldg PDI (1D-)</u>
3 field samples (analyzed by PLM NIOSH 9002)
concrete roofing material
Index IDs: 1D-01784, 1D-01787, 1D-01788
Sample Date 4/30/2004
All samples were <1% for TREM-ACT

<u>Aug 2004 Central Maintenance Bldg PDI (1D-)</u>
2 field samples (analyzed by PLM NIOSH 9002)
bulk insulation
Index IDs: 1D-01978, 1D-01979
Sample Date 8/12/2004
All samples were non-detect for TREM-ACT

Appendix C
Asbestos Analysis Methods and Data Reduction Techniques

ASBESTOS ANALYSIS METHODS AND DATA REDUCTION TECHNIQUES

1 Asbestos Mineralogy

Asbestos is the generic name for the fibrous habit of a broad family of naturally occurring poly-silicate minerals. Based on crystal structure, asbestos minerals are usually divided into two groups: serpentine and amphibole.

- *Serpentine*: The only asbestos mineral in the serpentine group is chrysotile. Chrysotile is the most widely used form of asbestos, accounting for about 90% of the asbestos used in commercial products (IARC 1977). There is no evidence that chrysotile occurs in the Libby vermiculite deposit, although it may be present in some types of building materials in Libby.

- *Amphiboles*: Five minerals in the amphibole group that occur in the asbestiform habit have found limited use in commercial products (IARC 1977), including:

    - actinolite
    - amosite
    - anthophyllite
    - crocidolite
    - tremolite

At the Libby site, the form of asbestos that is present in the vermiculite deposit is an amphibole asbestos that for many years was classified as tremolite/actinolite (e.g., McDonald et al 1986a, Amandus and Wheeler 1987). More recently, the U.S. Geological Service (USGS) performed electron probe micro-analysis and X-ray diffraction analysis of 30 samples obtained from asbestos veins at the mine (Meeker et al. 2003). Using mineralogical naming rules recommended by Leake et al. (1997), the results indicate that the asbestos at Libby includes a number of related amphibole types. The most common forms are winchite and richterite, with lower levels of tremolite, actinolite, and magnesioriebeckite. Because the mineralogical name changes that have occurred over the years do not alter the asbestos material that is present in Libby, and because EPA does not find that there are toxicological data to distinguish differences in toxicity among these different forms, the EPA does not believe that it is important to attempt to distinguish among these various amphibole types. Therefore, EPA simply refers to the mixture as Libby Amphibole (LA) asbestos.

2 Measurement Techniques for Asbestos in Air

In the past, the most common technique for measuring asbestos in air was phase contrast microscopy (PCM). In this technique, air is drawn through a filter and airborne particles become deposited on the face of the filter. All structures that have a length greater than 5 um and have an aspect ratio (the ratio of length to width) of 3:1 or more are counted as PCM fibers. The limit of resolution of PCM is about 0.25 um, so particles thinner than this are generally not observable.

A key limitation of PCM is that particle discrimination is based only on size and shape. Because of this, it is not possible to classify asbestos particles by mineral type, or even to distinguish between asbestos and non-asbestos particles. For this reason, nearly all samples of air collected in Libby are analyzed by transmission electron microscopy (TEM). This method operates at higher magnification (typically about 20,000x) and hence is able to detect structures much smaller than can been seen by PCM. In addition, TEM instruments are fitted with accessories that allow each particle to be classified according to mineral type.

3 Transmission Electron Microscopy (TEM)

3.1 Sample Preparation

If air samples were not deemed to be overloaded by particulates[1], filters are directly prepared for analysis by transmission electron microscopy (TEM) in accord with the preparation methods provided in ISO 10312 (ISO 1995).

If air samples are deemed to be overloaded, samples are prepared indirectly (either with or without ashing as determined by the analyst) in accord with the procedures in SOP EPA-LIBBY-08. In brief, rinsate or ashed residue from the original filter is suspended in water and sonicated. An aliquot of this water is applied to a second filter which is then used to prepare a set of TEM grids. Reported air concentrations for indirectly prepared samples incorporate a dilution factor, or F-factor (see Section 1.3.4 below).

3.2 Sample Analysis

Air and dust samples collected as part of the OU5 sampling programs were analyzed by TEM in basic accord with the counting and recording rules specified in ISO 10312 (ISO 1995), and the project-specific counting rule modifications specified in the respective SAPs. These modifications included changing the recording rule to include structures with an aspect ratio $\geq$ 3:1.

When a sample is analyzed by TEM, the analyst records the size (length, width) and mineral type of each individual asbestos structure that is observed. Mineral type is determined by Selected Area Electron Diffraction (SAED) and Energy Dispersive Spectroscopy (EDS), and each structure is assigned to one of the following four categories:

LA *Libby-class amphibole.* Structures having an amphibole SAED pattern and an elemental composition similar to the range of fiber types observed in ores from the Libby mine (Meeker et al. 2003). This is a sodic tremolitic solid solution series of minerals including actinolite, tremolite, winchite, and richterite, with lower amounts of magnesio-arfedsonite and edenite/ferro-edenite.

[1] Overloaded is defined as >25% obscuration on the majority of the grid openings (see Libby Laboratory Modification #LB-000016 and SOP EPA-LIBBY-08).

OA *Other amphibole-type asbestos fibers.* Structures having an amphibole SAED pattern and an elemental composition that is not similar to fiber types from the Libby mine. Examples include crocidolite, amosite, and anthophyllite. There is presently no evidence that these fibers are associated with the Libby mine.

C *Chrysotile fibers.* Structures having a serpentine SAED pattern and an elemental composition characteristic of chrysotile. There is presently no evidence that these fibers are associated with the Libby mine.

NAM *Non-asbestos material.* These may include non-asbestos mineral fibers such as gypsum, glass, or clay, and may also include various types of organic and synthetic fibers derived from carpets, hair, etc.

For the purposes of this report, air concentrations and dust loading values are based on countable LA structures only (i.e., results for other amphibole-type asbestos and chrysotile are not discussed).

3.3 Estimation of PCME

For the purposes of computing risk estimates, it is necessary to utilize the results from a TEM analysis to estimate what would have been detected had the sample been analyzed by PCM. This is because available toxicity information is usually based on workplace studies that utilized PCM as the primary method for analysis. For convenience, structures detected under TEM that meet the recording rules for PCM (i.e., length > 5 um, width ≥ 0.25 um, aspect ratio ≥ 3:1) are referred to as PCM-equivalent (PCME) structures.

There are two alternative approaches available for expressing units of PCME s/cc. The first (and most direct) approach is to express the concentration of each sample in terms of the PCME structures observed in that sample. The second approach is to express the concentration of LA in each sample in terms of the total LA in that sample, and then multiply the total LA concentration by a value that represents the average fraction of total LA structures that meet PCME counting rules. For this evaluation, the first approach was followed.

In this document, all air concentrations will be reported in units of PCME LA s/cc and all dust loading values will be reported in units of total LA s/cc.

3.4 Calculation of Air Concentrations

The concentration of LA in air is given by:

$$\text{Air Concentration (s/cc)} = N \cdot S$$

where:

N = Number of structures observed
S = Sensitivity (cc^{-1})

For air, the sensitivity is calculated as:

$$S = \frac{EFA}{GO \cdot Ago \cdot V \cdot 1000 \cdot F}$$

where:

S	=	Sensitivity for air (cc^{-1})
EFA	=	Effective area of the filter (mm^2)
GO	=	Number of grid openings examined
Ago	=	Area of a grid opening (mm^2)
V	=	Volume of air passed through the filter (L)
1000	=	Conversion factor (cc/L)
F	=	Fraction of primary filter deposited on secondary filter (indirect preparation only)

3.5 Combining Results from Multiple Samples

When the exposure metric of concern is the average concentration across a set of multiple samples, the best estimate of the mean concentration is calculated simply by averaging the individual concentration values. Note that samples with a count of zero (and hence a air concentration or dust loading of zero) are evaluated as zero when computing the best estimate of the mean (EPA 2008). This approach yields an unbiased estimate of the true mean that does not depend on the analytical sensitivity of the samples included in the data set.

3.6 Estimating Confidence Bounds

For an Individual Sample

The uncertainty around a TEM estimate of asbestos concentration in a sample is a function of the number of structures observed during the analysis. The 95% confidence interval around a count of N structures is given by:

LB = ½·CHIINV[0.025, 2N+1]
UB = ½·CHIINV[0.975, 2N+1]

where:

LB = Lower bound on the 95% confidence interval on N
UB = Upper bound on the 95% confidence interval on N
CHIINV = Inverse chi-squared cumulative distribution function
N = Number of structures observed

As N increases, the absolute width of the confidence interval increases, but the relative uncertainty [expressed as the confidence interval (CI) divided by the observed value (N)] decreases. This is illustrated in the table below.

Relationship Between Number of Structures Observed and Relative Uncertainty

Number of Structures Observed (N)	2.5% Lower Bound N (LB)	97.5% Upper Bound N (UB)	95% Confidence Interval Range (CI) [UB-LB]	Relative Uncertainty [CI/N]
0	0.00	2.51	2.51	+Infinity
1	0.11	4.67	4.57	457%
2	0.42	6.42	6.00	300%
3	0.84	8.01	7.16	239%
5	1.91	10.96	9.05	181%
10	5.14	17.74	12.60	126%
20	12.61	30.28	17.67	88%
50	37.54	65.35	27.81	56%
75	59.44	93.46	34.02	45%
100	81.82	121.08	39.26	39%

2.5% LB = 0.5 · CHIINV[0.975, (2 · N+1)]
97.5% UB = 0.5 · CHIINV[0.025, (2 · N+1)]

Using this approach, the equation for calculation of the upper and lower bounds on the air concentration of asbestos structures is:

Air Concentration (s/cc) = (LB or UB) · S

where:

LB or UB = Number of structures based on lower bound (LB) or upper bound (UB)
S = Sensitivity (cc^{-1} for air)

Across Multiple Samples

Calculation of the uncertainty bounds around the average of a group of asbestos samples is complicated by the fact that the between-sample variability in the measured concentration values includes the between-sample variability that arises from both analytical measurement error in individual samples and from between-sample temporal or spatial variability. EPA has not yet developed a method for calculating uncertainty bounds around the mean of asbestos data sets, so no uncertainty bounds are provided in this report for mean values (EPA 2008). However, it is important to recognize that the values are uncertain, and that actual values might be either higher or lower than reported.

4 Polarized Light Microscopy Analysis (PLM)

4.1 Sample Preparation

Soil samples collected as part of the OU5 sampling programs were prepared for analysis in accord with SOP ISSI-LIBBY-01 as specified in the CDM Close Support Facility (CSF) Soil Preparation Plan (SPP) (CDM 2004). In brief, each soil sample is dried and sieved through a ¼ inch screen. Particles retained on the screen (if any) are referred to as the "coarse" fraction. Particles passing through the screen are referred to as the fine fraction, and this fraction is ground by passing it through a plate grinder. The resulting material is referred to as the "fine ground" fraction. The fine ground fraction is split into four equal aliquots; one aliquot is submitted for analysis and the remaining aliquots are archived at the CSF.

4.2 Sample Analysis

Soil samples collected at the Libby Site are analyzed using polarized light microscopy (PLM). The coarse fractions were examined using stereomicroscopy, and any particles of asbestos (confirmed by PLM) were removed and weighed in accord with SRC-LIBBY-01 (referred to as "PLM-Grav"). The fine ground aliquots were analyzed using a Libby-specific PLM method using visual area estimation, as detailed in SOP SRC-LIBBY-03. For convenience, this method is referred to as "PLM-VE".

PLM-VE is a semi-quantitative method that utilizes site-specific LA reference materials to allow assignment of fine ground samples into one of four "bins", as follows:

- *Bin A (ND):* non-detect
- *Bin B1 (Trace):* detected at levels lower than the 0.2% LA reference material
- *Bin B2 (<1%):* detected at levels lower than the 1% LA reference material but higher than the 0.2% LA reference material
- *Bin C:* LA detected at levels greater than or equal to the 1% LA reference material

Of the 985 soil field samples collected during these OU5 sampling programs, 739 samples had a coarse fraction, and all but one[2] of these samples was reported as non-detect for LA when analyzed by PLM-Grav. In this case, the PLM-VE result was "<1". Because of this, this report focuses on the PLM-VE results for the fine ground fraction only.

5 Soil Visual Inspection

At the time of soil sample collection for PLM analysis, the sampling team performed a visual inspection of the displaced soil at each sampling point to determine if visible vermiculite was

[2] PLM-Grav result for this sample was reported as "Tr".

present in accord with SOP CDM-LIBBY-06. A semi-quantitative estimate (none, low, moderate[3], high) of the amount of visible vermiculite present was noted for each sampling point. For composite samples, a count of the number of sampling points assigned to each visible vermiculite ranking was recorded on the Field Sample Data Sheet (FSDS) in the sample comments (e.g., 18 none [X], 6 low [L], 4 moderate [M], 2 high [H]).

There are several alternative ways that this visual inspection data can be used to characterize the level of vermiculite contamination (and presumptive LA contamination) in an area.

Option 1: Present/Absent

The simplest strategy classifies an area either as "Vis –" if all sampling points in the composite were assigned a value of "none", or as "Vis +" if one or more of the sampling points were assigned a value of "low", "moderate", or "high".

A potential limitation to this ranking strategy is that it does not account for differences in the amount or frequency of visible vermiculite detections. For example, an area with 1 "low" point and 29 "none" points and an area with 24 "moderate" points and 5 "high" points would both be ranked as "Vis +".

Option 2: Detection Frequency

In this approach, an area is assigned a value equal to the detection frequency by visible inspection. For example, an area with 1 "low" point and 29 "none" points would receive a value of 1/30 (3.3%), while an area with 24 "moderate" points and 5 "high" points would receive a score of 29/30 (97%).

While this approach does account for the frequency of visible vermiculite, it does not consider the amount vermiculite observed. In other words, an ABS area with 5 "low" points and 25 "none" points would have the same detection frequency of 5/30 (17%) as an ABS area with 5 "high" points and 25 "none" points.

Option 3: Amount-Weighted Score

In this approach, both the frequency and the level of vermiculite are considered. This is achieved by assigning a weighting factor to each level, where the weighting factors are intended to represent the relative levels of vermiculite in each category. As presented in SOP CDM-LIBBY-06, the guidelines for assigning levels are as follows:

None =	No flakes of vermiculite detected observed within the inspection point.
Low =	A maximum of a few flakes of vermiculite observed within the inspection point.

[3] The visual inspection SOP CDM-LIBBY-06 uses the terminology "intermediate" to refer to the "moderate" classification. For the purposes of this document, the term "moderate" is retained to correspond with the accompanying field documentation.

Moderate/High = Vermiculite easily observed throughout the inspection point, including the surface. A ranking of High is reserved for samples that are 50% or more vermiculite. Others (<50%) are assigned a ranking of Moderate.

Based on these descriptions, the weighting factors that were used to calculate scores are as follows:

Visible Vermiculite Level (L_i)	Weighting factor (W_i)
None	0
Low	1
Moderate	3
High	10

The score is then the weighted sum of the observations for the area:

$$Score = \frac{\sum_{i=1}^{x} L_i \cdot W_i}{x}$$

This value can range from zero (all points are "none") to a maximum of 10 (all points are "high"). For example, an area with 1 "low" point and 29 "none" points would receive a value of 1/30 = 0.033, while an area with 24 "moderate" points and 5 "high" would receive a score of (24·3 + 5·10) / 30 = 4.13.

Appendix D
Analytical and Other Data

Appendix D1
Scribe Database

Scribe database is available on CD by request.

Contact the EPA Records Center to request a copy: 303-312-6473.

Appendix D2
Scribe Queries

SRC Air Results Queries for OU5 Scribe

SRC_Air Total LA Concentration Data
Purpose:
The purpose is to select binned air analytical results for field samples that have been analyzed by TEM. Results for LA particles from analyses that are not lab QC are selected.

SQL Code:
```
SELECT Samples.Samp_No, Samples.SampleDate, Samples.Location, Samples.Sub_Location,
Samples.Matrix, Samples.Sub_Matrix, Samples.SampleType, Samples.Remarks,
Analysis.AnalysisMethod, Analysis.AnalysisDate, Analysis.AnalysisLabID, Analysis.AnalysisPrepMethod,
Analysis.AnalysisLabSampleID, Analysis.AnalysisLabJobNumber, Analysis.AnalysisFilterStatus,
Analysis.AnalysisGOSize, Analysis.AnalysisGOCounted, Analysis.AnalysisEFA,
Analysis.AnalysisFFactor, Analysis.AnalysisQuantityAnalyzed, Analysis.AnalysisQuantityAnalyzedUnits,
Analysis.AnalysisLabQCType, LabResults.Result, LabResults.Result_Qualifier,
LabResults.Lab_Result_Qualifier, LabResults.Result_Units, LabResults.Comments,
LabResults.CharacteristicID, LabResults.ResultMineralClass
FROM (LabResults INNER JOIN Analysis ON LabResults.AnalysisID = Analysis.AnalysisID) INNER JOIN
Samples ON Analysis.Samp_No = Samples.Samp_No
WHERE (((Samples.Matrix)="air") AND ((Samples.SampleType)="field sample") AND
((Analysis.AnalysisFilterStatus)="analyzed") AND ((Analysis.AnalysisLabQCType)="not qa") AND
((LabResults.ResultMineralClass)="la"));
SRC_Soil Results_PLM9002_Part1
```

SRC_Air Concentration Data_Raw Struc_Part1
Purpose:
The purpose is to select raw structure data for air samples that have been analyzed by TEM.

SQL Code:
```
SELECT Samples.Samp_No, Samples.SampleDate, Samples.Location, Samples.Sub_Location,
Samples.Matrix, Samples.Sub_Matrix, Samples.SampleType, Samples.Remarks,
Analysis.AnalysisMethod, Analysis.AnalysisDate, Analysis.AnalysisLabID, Analysis.AnalysisPrepMethod,
Analysis.AnalysisLabSampleID, Analysis.AnalysisLabJobNumber, Analysis.AnalysisFilterStatus,
Analysis.AnalysisGOSize, Analysis.AnalysisGOCounted, Analysis.AnalysisEFA,
Analysis.AnalysisFFactor, Analysis.AnalysisQuantityAnalyzed, Analysis.AnalysisQuantityAnalyzedUnits,
Analysis.AnalysisLabQCType, Structures.Grid, Structures.GridOpening, Structures.StructureType,
Structures.Primary, Structures.Total, Structures.Length, Structures.Width, Structures.MineralClass,
[Length]/[Width] AS AR, Structures.StructureIdentification
FROM (Analysis INNER JOIN Samples ON Analysis.Samp_No = Samples.Samp_No) INNER JOIN
Structures ON Analysis.AnalysisID = Structures.AnalysisID
WHERE (((Samples.Matrix)="air") AND ((Analysis.AnalysisFilterStatus)="analyzed"));
```

SRC_Air Concentration Data_Raw Struc_Part2
Purpose:
This query is a continuation of "SRC_Air Concentration Data_Raw Struc_Part1".
The purpose is to select LA raw structure data for field samples that are not lab QC analyses.

SQL Code:
```
SELECT [SRC_Air Concentration Data_Raw Struc_Part1].Samp_No, [SRC_Air Concentration Data_Raw
Struc_Part1].SampleDate, [SRC_Air Concentration Data_Raw Struc_Part1].Location, [SRC_Air
Concentration Data_Raw Struc_Part1].Sub_Location, [SRC_Air Concentration Data_Raw
Struc_Part1].Matrix, [SRC_Air Concentration Data_Raw Struc_Part1].Sub_Matrix, [SRC_Air
Concentration Data_Raw Struc_Part1].SampleType, [SRC_Air Concentration Data_Raw
Struc_Part1].Remarks, [SRC_Air Concentration Data_Raw Struc_Part1].AnalysisMethod, [SRC_Air
Concentration Data_Raw Struc_Part1].AnalysisDate, [SRC_Air Concentration Data_Raw
Struc_Part1].AnalysisLabID, [SRC_Air Concentration Data_Raw Struc_Part1].AnalysisPrepMethod,
```

```
[SRC_Air Concentration Data_Raw Struc_Part1].AnalysisLabSampleID, [SRC_Air Concentration
Data_Raw Struc_Part1].AnalysisLabJobNumber, [SRC_Air Concentration Data_Raw
Struc_Part1].AnalysisFilterStatus, [SRC_Air Concentration Data_Raw Struc_Part1].AnalysisGOSize,
[SRC_Air Concentration Data_Raw Struc_Part1].AnalysisGOCounted, [SRC_Air Concentration
Data_Raw Struc_Part1].AnalysisEFA, [SRC_Air Concentration Data_Raw Struc_Part1].AnalysisFFactor,
[SRC_Air Concentration Data_Raw Struc_Part1].AnalysisQuantityAnalyzed, [SRC_Air Concentration
Data_Raw Struc_Part1].AnalysisQuantityAnalyzedUnits, [SRC_Air Concentration Data_Raw
Struc_Part1].AnalysisLabQCType, [SRC_Air Concentration Data_Raw Struc_Part1].Grid, [SRC_Air
Concentration Data_Raw Struc_Part1].GridOpening, [SRC_Air Concentration Data_Raw
Struc_Part1].StructureType, [SRC_Air Concentration Data_Raw Struc_Part1].Primary, [SRC_Air
Concentration Data_Raw Struc_Part1].Total, [SRC_Air Concentration Data_Raw Struc_Part1].Length,
[SRC_Air Concentration Data_Raw Struc_Part1].Width, [SRC_Air Concentration Data_Raw
Struc_Part1].AR, [SRC_Air Concentration Data_Raw Struc_Part1].MineralClass, [SRC_Air Concentration
Data_Raw Struc_Part1].StructureIdentification, IIf([Length]>5 And [Width]>=0.25 And [AR]>=3 And
[MineralClass] Like "LA" And [Total]>0,1,0) AS PCMEla, IIf([Length]>10 And [AR]>=3 And [MineralClass]
Like "LA" And [Total]>0,1,0) AS BCla
FROM [SRC_Air Concentration Data_Raw Struc_Part1]
WHERE ((([SRC_Air Concentration Data_Raw Struc_Part1].Matrix)="air") AND (([SRC_Air Concentration
Data_Raw Struc_Part1].SampleType)="field sample") AND (([SRC_Air Concentration Data_Raw
Struc_Part1].AnalysisFilterStatus)="analyzed") AND (([SRC_Air Concentration Data_Raw
Struc_Part1].AnalysisLabQCType)="not qa"));
```

SRC Soil Results Queries for OU5 Scribe

SRC_Soil PLMVE Min Analysis Date

Purpose:

Select the first analysis performed for a sample. This is the true "NOT QA". For PLM-VE subsequent analyses have been performed on samples and the database does not correctly identify these. The main reason for this is that the laboratories do not know that they are performing a QC analysis and therefor do not identify them as such. This has been recognized as a problem, but the only solution to it is to change the database after the fact and this has not happened yet and it is uncertain if this ever will happen.

SQL Code:

```
SELECT Analysis.Samp_No, Analysis.AnalysisMethod, Min(Analysis.AnalysisDate) AS
MinOfAnalysisDate
FROM Analysis
GROUP BY Analysis.Samp_No, Analysis.AnalysisMethod
HAVING (((Analysis.AnalysisMethod)="PLM-VE"));
```

SRC_Soil Results_PLM9002_Part1

Purpose:

List all soil samples analyzed by PLM-9002.

SQL Code:

```
SELECT Samples.Samp_No, Location.Latitude, Location.Longitude, Location.Datum,
Samples.SampleType, Samples.SampleDate, Samples.Location, Samples.Sub_Location,
Samples.Matrix, Samples.Sub_Matrix, Min(Analysis.AnalysisDate) AS MinOfAnalysisDate,
Analysis.AnalysisLabQCType, LabResults.CharacteristicID, LabResults.Result,
LabResults.Result_Qualifier, LabResults.Result_Units,
IIf([LabResults]![Result_Qualifier]="ND","ND",IIf([LabResults]![Result_Qualifier]="Tr","TR",IIf([LabResults]!
[Result_Qualifier]="<","<1",[LabResults]![Result]))) AS [9002 Result (%)], LabResults.ResultMineralClass
FROM Location INNER JOIN ((LabResults INNER JOIN Analysis ON LabResults.AnalysisID =
Analysis.AnalysisID) INNER JOIN Samples ON Analysis.Samp_No = Samples.Samp_No) ON
Location.Location = Samples.Location
GROUP BY Samples.Samp_No, Location.Latitude, Location.Longitude, Location.Datum,
Samples.SampleType, Samples.SampleDate, Samples.Location, Samples.Sub_Location,
Samples.Matrix, Samples.Sub_Matrix, Analysis.AnalysisLabQCType, LabResults.CharacteristicID,
LabResults.Result, LabResults.Result_Qualifier, LabResults.Result_Units,
IIf([LabResults]![Result_Qualifier]="ND","ND",IIf([LabResults]![Result_Qualifier]="Tr","TR",IIf([LabResults]!
[Result_Qualifier]="<","<1",[LabResults]![Result]))), LabResults.ResultMineralClass,
LabResults.Analytical_Method
HAVING (((Samples.SampleType)="field sample") AND ((Samples.Matrix)="soil") AND
((Samples.Sub_Matrix) Like "*soil*") AND ((Analysis.AnalysisLabQCType)="not qa") AND
((LabResults.Analytical_Method)="PLM-9002"));
```

SRC_Soil Results_PLM9002_Part2

Purpose:

Transpose soil data_PLM-9002_part1.

SQL Code:

```
TRANSFORM Max([SRC_Soil Results_PLM9002_Part1].[9002 Result (%)]) AS [MaxOf9002 Result (%)]
SELECT [SRC_Soil Results_PLM9002_Part1].Samp_No, [SRC_Soil Results_PLM9002_Part1].Latitude,
[SRC_Soil Results_PLM9002_Part1].Longitude, [SRC_Soil Results_PLM9002_Part1].Datum, [SRC_Soil
Results_PLM9002_Part1].SampleType, [SRC_Soil Results_PLM9002_Part1].SampleDate, [SRC_Soil
Results_PLM9002_Part1].Location, [SRC_Soil Results_PLM9002_Part1].Sub_Location, [SRC_Soil
Results_PLM9002_Part1].Matrix, [SRC_Soil Results_PLM9002_Part1].Sub_Matrix, [SRC_Soil
Results_PLM9002_Part1].MinOfAnalysisDate, [SRC_Soil Results_PLM9002_Part1].AnalysisLabQCType
FROM [SRC_Soil Results_PLM9002_Part1]
```

```
GROUP BY [SRC_Soil Results_PLM9002_Part1].Samp_No, [SRC_Soil Results_PLM9002_Part1].Latitude, [SRC_Soil Results_PLM9002_Part1].Longitude, [SRC_Soil Results_PLM9002_Part1].Datum, [SRC_Soil Results_PLM9002_Part1].SampleType, [SRC_Soil Results_PLM9002_Part1].SampleDate, [SRC_Soil Results_PLM9002_Part1].Location, [SRC_Soil Results_PLM9002_Part1].Sub_Location, [SRC_Soil Results_PLM9002_Part1].Matrix, [SRC_Soil Results_PLM9002_Part1].Sub_Matrix, [SRC_Soil Results_PLM9002_Part1].MinOfAnalysisDate, [SRC_Soil Results_PLM9002_Part1].AnalysisLabQCType
PIVOT [SRC_Soil Results_PLM9002_Part1].CharacteristicID;
```

SRC_Soil Results_PLMGrav

Purpose:

List results for soil samples analyzed by PLM-Grav. The result is the ResultsQualifier ; this is populated in a new column titled “GRAV RESULT (%)”.

SQL Code:

```
SELECT Samples.Samp_No, Location.Latitude, Location.Longitude, Location.Datum, Samples.SampleType, Samples.SampleDate, Samples.Location, Samples.Sub_Location, Samples.Matrix, Samples.Sub_Matrix, Min(Analysis.AnalysisDate) AS MinOfAnalysisDate, Analysis.AnalysisLabQCType, IIf([LabResults]![Result_Qualifier]="ND","ND",IIf([LabResults]![Result_Qualifier]="Tr","TR",IIf([LabResults]![Result_Qualifier]="<","<1",[LabResults]![Result]))) AS [GRAV Result (%)]
FROM Location INNER JOIN ((LabResults INNER JOIN Analysis ON LabResults.AnalysisID = Analysis.AnalysisID) INNER JOIN Samples ON Analysis.Samp_No = Samples.Samp_No) ON Location.Location = Samples.Location
GROUP BY Samples.Samp_No, Location.Latitude, Location.Longitude, Location.Datum, Samples.SampleType, Samples.SampleDate, Samples.Location, Samples.Sub_Location, Samples.Matrix, Samples.Sub_Matrix, Analysis.AnalysisLabQCType, IIf([LabResults]![Result_Qualifier]="ND","ND",IIf([LabResults]![Result_Qualifier]="Tr","TR",IIf([LabResults]![Result_Qualifier]="<","<1",[LabResults]![Result]))), LabResults.ResultMineralClass, LabResults.Analytical_Method
HAVING (((Samples.SampleType)="field sample") AND ((Samples.Matrix)="soil") AND ((Samples.Sub_Matrix) Like "*soil*") AND ((Analysis.AnalysisLabQCType)="not qa") AND ((LabResults.ResultMineralClass)="la") AND ((LabResults.Analytical_Method) Like "*grav*"));
```

SRC_Soil Results_PLMVE

Purpose:

List results for soil samples analyzed by PLM-VE. The result is the ResultsQualifier ; this is populated in a new column titled “VE MF RESULT (%)”.

SQL Code:

```
SELECT Samples.Samp_No, Location.Latitude, Location.Longitude, Location.Datum, Samples.SampleType, Samples.SampleDate, Samples.Location, Samples.Sub_Location, Samples.Matrix, Samples.Sub_Matrix, Min(Analysis.AnalysisDate) AS MinOfAnalysisDate, Analysis.AnalysisLabQCType, IIf([LabResults]![Result_Qualifier]="ND","ND",IIf([LabResults]![Result_Qualifier]="Tr","TR",IIf([LabResults]![Result_Qualifier]="<","<1",[LabResults]![Result]))) AS [VE MF Result (%)]
FROM [SRC_Soil PLMVE Min Analysis Date] INNER JOIN (Location INNER JOIN ((LabResults INNER JOIN Analysis ON LabResults.AnalysisID=Analysis.AnalysisID) INNER JOIN Samples ON Analysis.Samp_No=Samples.Samp_No) ON Location.Location=Samples.Location) ON ([SRC_Soil PLMVE Min Analysis Date].Samp_No=Analysis.Samp_No) AND ([SRC_Soil PLMVE Min Analysis Date].MinOfAnalysisDate=Analysis.AnalysisDate)
GROUP BY Samples.Samp_No, Location.Latitude, Location.Longitude, Location.Datum, Samples.SampleType, Samples.SampleDate, Samples.Location, Samples.Sub_Location, Samples.Matrix, Samples.Sub_Matrix, Analysis.AnalysisLabQCType, IIf([LabResults]![Result_Qualifier]="ND","ND",IIf([LabResults]![Result_Qualifier]="Tr","TR",IIf([LabResults]!
```

```
[Result_Qualifier]="<","<1",[LabResults]![Result]))), LabResults.ResultMineralClass,
LabResults.CharacteristicID, LabResults.Analytical_Method
HAVING (((Samples.SampleType)="field sample") AND ((Samples.Matrix)="soil") AND
((Samples.Sub_Matrix) Like "*soil*") AND ((Analysis.AnalysisLabQCType)="not qa") AND
((LabResults.ResultMineralClass)="la") AND ((LabResults.CharacteristicID)="mfla") AND
((LabResults.Analytical_Method) Like "*ve*"));
```

SRC_Soil Results_ALL

Purpose:

Combine results for all methods available for each sample.

SQL Code:

```
SELECT Samples.Samp_No, Location.Latitude, Location.Longitude, Location.Datum,
Samples.SampleType, Samples.SampleDate, Samples.Location, Samples.Sub_Location,
Samples.Matrix, Samples.Sub_Matrix, Min(Analysis.AnalysisDate) AS MinOfAnalysisDate1,
Analysis.AnalysisLabQCType, [SRC_Soil Results_PLM9002_Part2].[TREM-ACTN] AS [9002 TREM-
ACTN (%)], [SRC_Soil Results_PLMGrav].[GRAV Result (%)], [SRC_Soil Results_PLMVE].[VE MF
Result (%)], Samples.Remarks
FROM ([SRC_Soil Results_PLMGrav] RIGHT JOIN ((Location INNER JOIN (Analysis INNER JOIN
Samples ON Analysis.Samp_No = Samples.Samp_No) ON Location.Location = Samples.Location) LEFT
JOIN [SRC_Soil Results_PLMVE] ON Analysis.Samp_No = [SRC_Soil Results_PLMVE].Samp_No) ON
[SRC_Soil Results_PLMGrav].Samp_No = Analysis.Samp_No) LEFT JOIN [SRC_Soil
Results_PLM9002_Part2] ON Analysis.Samp_No = [SRC_Soil Results_PLM9002_Part2].Samp_No
GROUP BY Samples.Samp_No, Location.Latitude, Location.Longitude, Location.Datum,
Samples.SampleType, Samples.SampleDate, Samples.Location, Samples.Sub_Location,
Samples.Matrix, Samples.Sub_Matrix, Analysis.AnalysisLabQCType, [SRC_Soil
Results_PLM9002_Part2].[TREM-ACTN], [SRC_Soil Results_PLMGrav].[GRAV Result (%)], [SRC_Soil
Results_PLMVE].[VE MF Result (%)], Samples.Remarks
HAVING (((Samples.SampleType)="field sample") AND ((Samples.Matrix)="soil") AND
((Samples.Sub_Matrix) Like "*soil*") AND ((Analysis.AnalysisLabQCType)="not qa"));
```

Appendix E
Data Quality Assessment

Appendix E
Data Quality Assessment

Data quality assessment (DQA) is the process of reviewing existing data to establish the quality of the data and to determine how any data quality limitations may influence data interpretation (EPA 2006).

For the purposes of the risk assessment, the principle datasets utilized to quantify potential exposures are the air samples collected during the various activity-based sampling (ABS) programs at the OU5 Site. In addition, soil data (both visible vermiculite inspection results and polarized light microscopy visual area estimation [PLM-VE] results) are utilized in the interpretation of the outdoor worker ABS results. Therefore, this DQA focuses on the ABS air samples and the site-wide soil samples used to support the OU5 risk assessment.

1 Audits

1.1 Field Audits

Field audits are conducted to evaluate field personnel in their day-to-day activities and ensure all processes and procedures are performed in accord with the applicable field guidance documents (or approved Libby Field Office [LFO] modification forms) to make certain that samples collected are correct and consistent. All aspects of data documentation and sample collection, as well as sample handling, custody, and shipping are evaluated. If any issues are identified, field personnel are notified and retrained as appropriate.

A field audit was performed on September 17, 2008, to evaluate field procedures for air samples collected as part of the MotoX Park and Recreational Visitor ABS programs. The auditor concluded that the field personnel were very effective and efficient at implementing sampling and reporting ABS program requirements and commended the field personnel and staff for their efforts in maintaining an effective field program and their persistent focus on detail and quality (Updike 2009).

1.2 Laboratory Audits

Laboratory audits are conducted to evaluate laboratory personnel to ensure that samples are handled and analyzed in accord with the program-specific documents and analytical method requirements (or approved Libby laboratory modification forms) to make certain that analytical results reported are correct and consistent. All aspects of sample handling, preparation, and analysis are evaluated. If any issues are identified, laboratory personnel are notified and retrained as appropriate.

A series of laboratory audits was performed in the Summer/Fall of 2008 to evaluate all of the Libby laboratories. No critical deficiencies were noted during the laboratory audits that would be expected to impact data quality.

2 Modifications

During any large-scale sampling program, such as the OU5 ABS programs, deviations from the original Sampling and Analysis Plan (SAP) may occur and/or it may be necessary to modify procedures identified in the original SAP to optimize sample collection and analysis. At the Libby Site, all field and laboratory modifications are recorded in site-specific modification forms. These forms provide a standardized format for tracking procedural changes in sample collection and analysis and allow project managers to assess potential impacts on the quality of the data being collected.

During the OU5 programs, a number of field and laboratory modifications were created that document changes in sample collection and analysis methodology specified in the original SAPs. Table E-1 summarizes the modifications that are applicable to the various programs at the OU5 Site, and notes the impact of each on the quality and usability of the data. As indicated, most of the modifications are not expected to have an impact on data quality or usability. Modifications which may have influenced the achieved analytical sensitivities could have potential impacts on data quality and interpretation. These potential impacts are discussed in more detail in Section 1.5, the data adequacy evaluation.

3 Data Verification

The Libby Site project database has a number of built-in quality control checks to identify unexpected or unallowable data values during the upload of any new data into the database. Any issues identified by these automatic upload checks were resolved by consultation with the field teams and/or analytical laboratories before entry of the data into the database. After entry of the data into the database, several additional data verification steps were taken to ensure the data were recorded and entered correctly.

In order to ensure that the database accurately reflects the original hard copy documentation, all data downloaded from the database were examined to identify data omissions, unexpected values, or apparent inconsistencies. In addition, 10% of all samples and analytical results underwent a detailed verification. In brief, verification involves comparing the data for a sample in the database to information on the original hard copy field sample data sheet (FSDS) form and on the original hard copy analytical bench sheets for that sample. Any omissions or apparent errors identified during the verification were submitted to the field teams and/or analytical laboratories for resolution and rectification in the project database and in the hard copy documentation.

FSDS Review. Hard copy FSDS forms were reviewed for a total of 42 ABS air samples as part of the data verification effort. While a few minor typographical errors were noted, no critical errors (i.e., errors that would influence the quantitative analytical results reported for the sample) were identified during this verification effort.

TEM Review. A total of 42 transmission electron microscopy (TEM) analyses were reviewed as part of the data verification effort. Attachment 1 presents a summary of the findings of the TEM data verification for the OU5 Site. In general, the majority of issues identified were due to the incorrect transfer of data from the hard copy report to the EDD (e.g., structure lengths were rounded, photo reference numbers were incorrect). However, it is important to note that none of the errors identified were critical in nature (i.e., critical errors are those that would influence the quantitative results).

PLM Review. A total of 108 PLM analyses were reviewed as part of the data verification effort. Attachment 2 presents a summary of the findings of the PLM data verification for the OU5 Site. The data verification identified critical errors in the reported PLM-VE bin for two soil samples (error rate of ~2%). Results for these samples have been corrected. There were also several findings that involve the incorrect transfer of data from the hard copy report to the EDD; however, none of these errors were critical in nature. While the critical error rate was low, future data verification of additional PLM results may be warranted.

All issues identified during the data verification effort were submitted to the field teams and/or analytical laboratories for resolution and rectification. All tables, figures, and appendices generated for this report reflect corrected data.

4 Quality Control Sample Summary

A number of Quality Control (QC) samples were collected as part of the ABS programs to help characterize the accuracy and precision of the data obtained. QC samples included both field-based samples (which are submitted blind to the laboratories) and laboratory-based samples.

4.1 Field QC Samples

4.1.1 Air and Dust

Lot Blanks

A lot blank is a filter cassette which has been taken from a new box of filter cassettes. Lot blanks are collected to ensure that sample filter cassettes do not have any asbestos contamination prior to their use in the field. If any asbestos structures are observed on the lot blank during the TEM analysis, the entire box of filter cassettes associated with that lot is discarded.

In accord with the OU5 ABS SAPs, one lot blank was submitted for every 500 air filter cassettes and every 300 dust filter cassettes. A total of 14 lot blanks were analyzed during the time of the OU5 ABS programs (i.e., October 2007 to October 2008). No asbestos structures were observed in any lot blank sample. Based on these results, it is concluded that air and dust filter cassettes utilized during the various OU5 ABS programs did not have asbestos contamination.

Field Blanks

A field blank is a filter cassette that is taken to the field and opened, but through which no air is drawn. Field blank samples for air are prepared for TEM analysis using a direct preparation, while field blank samples for dust are prepared using an indirect preparation.

In accord with the OU5 ABS SAPs, field blanks for air and dust were collected at a rate of one per property per day. Approximately 10% of the total field blanks collected per week were analyzed by TEM. The field blanks selected for analysis ranged across the duration of the OU5 ABS programs.

A total of 22 air field blanks and 8 dust field blanks were collected during the time of the OU5 ABS programs (i.e., October 2007 to October 2008) and analyzed by TEM. No asbestos structures were observed in any of the analyzed field blank samples. This demonstrates that filter contamination due from either field or laboratory sources is not expected to influence asbestos results for samples collected as part of the OU5 ABS programs.

Field Duplicates/Replicates

A field duplicate or replicate is a second sample of air or dust which is collected at the same time and location as the original field sample. These samples are collected independent of the original field sample with separate sampling equipment. Field duplicates or replicates help to evaluate the inherent variability of sample results due to small-scale variability in concentration as well as variability in sample analysis.

A total of 3 air field replicates and 2 dust field duplicates were collected as part of the OU5 ABS programs. Table E-2 summarizes the detailed TEM results for all field duplicate/replicate samples collected. The total Libby amphibole (LA) asbestos concentration estimates derived from the original and duplicate/replicate samples are compared using the method for comparison of two Poisson rates described by Nelson (1982). As seen, in most cases, both the original and the duplicate/replicate results were non-detect (i.e., not statistically different from each other). For the one dust sample where LA structures were observed, the difference between the original and the dust duplicate results were not statistically different. Based on this, it is concluded that air and dust sample results are reproducible, at least within the target analytical sensitivity.

4.1.2 Soil

Field Duplicates

A field duplicate for soil is an independent sample of soil collected at the same place and at the same time as the primary sample. Field duplicates for soil were collected at a rate of about 1 field duplicate per 20 field samples in accordance with the frequencies specified in the Outdoor Worker ABS SAP (EPA 2008b), resulting in 37 field duplicates (out of 744 field samples).

Field duplicate results analyzed by PLM are ranked as concordant if both the original sample result and the field duplicate result report the same semi-quantitative bin classification. Results are ranked as weakly discordant if the original sample result and the field duplicate result differed by one semi-quantitative bin classification (e.g., Bin A vs. Bin B1). Results are ranked as strongly discordant if the original sample result and the field duplicate result differed by more than one semi-quantitative bin classification (e.g., Bin A vs. Bin B2). Results are evaluated based on the frequency of strongly discordant results, using the criteria contained in the table below.

Metric	Good	Acceptable	Poor
% of pairs ranked as strongly discordant	<5%	5-10%	>10%

Table E-3 summarizes the results of the original and field duplicate samples for soil. As seen, most samples (35 out of 37) were ranked as non-detect in both the original sample result and the field duplicate result. For the two sample pairs that were ranked as discordant, the results were only weakly discordant. This discordance may be due to analytical variability, but might also arise from authentic heterogeneity between the soil samples. No sample pairs were ranked as strongly discordant.

These results support the conclusion that estimates of soil concentration by PLM are generally reproducible, and are not greatly influenced by potential differences in field collection methods, small-scale spatial variability, or laboratory preparation and analysis techniques.

4.2 Soil Preparation Laboratory QC Samples

4.2.1 Preparation Blanks

A preparation blank consists of asbestos-free quartz sand which is processed with each batch of soil samples. A batch of samples is defined as a group of samples that have been prepared together for analysis at the same time. Preparation blanks determine if cross-contamination is occurring during sample preparation processing (i.e., drying, sieving, grinding, and splitting).

A total of 119 preparation blanks were analyzed by PLM-VE during the time of the OU5 ABS programs. No asbestos was detected in any blank sample. Based on these results, it is concluded that preparation methods at the soil preparation laboratory were unlikely to introduce LA contamination that would result in a quantifiable impact on soil results analyzed by PLM-VE.

4.2.2 Preparation Splits

Preparation splits are splits of field samples submitted for soil sample preparation. After drying but prior to sieving, the original field sample is split into two equal aliquots using the Jones splitter. One preparation split is included for every 20 field samples prepared. Comparison of the results for preparation split with the paired original field samples helps to evaluate the variability that arises during the preparation and analysis steps. Concordance between the preparation split analysis and the original analysis is evaluated using a methodology similar to that described above for field duplicates.

Table E-4 summarizes the PLM-VE results of the original and preparation split samples for soil. As seen, all samples (42 out of 42) were ranked as non-detect (Bin A) in both the original sample result and the preparation split result. These results support the conclusion that the soil sample results are generally reproducible and reliable and are not greatly influenced by differences in laboratory preparation and analysis techniques.

4.2.3 Performance Evaluation Samples

A performance evaluation (PE) sample is a soil sample with a known level of LA that is provided blind to the laboratories for the purposes of evaluating analytical accuracy. PE samples of LA were created as part of the PE Study (EPA 2000; 2003a,b) by spiking uncontaminated soil from Libby with a known amount of asbestos material derived from the mine in Libby. PE samples are inserted into the soil sample train by the soil preparation laboratory at the time of sample preparation.

To date, a total of 34 PE samples have been submitted to the PLM-VE analytical laboratories for analysis. In order to avoid “unblinding” the nominal levels in the PE samples to the analytical laboratories, detailed results tables are not presented in this report. In general, the PLM-VE results provided by the analytical laboratory for all PE samples were fairly consistent with the expected result based on the nominal level. When results were discordant, the laboratories tended to overestimate LA levels in soil compared to nominal levels. These results support the conclusion that the PLM-VE results generally tend to be accurate and reliable.

4.3 Analytical Laboratory QC Samples

4.3.1 TEM Analytical Laboratory QC

Laboratory Blanks

A laboratory blank for TEM is a grid that is prepared from a new, un-used filter by the laboratory and is analyzed using the same procedure as used for field samples. The purpose of the laboratory blank is to determine if there are any significant sources of contamination arising during sample preparation or analysis in the laboratory. As specified in Libby Laboratory Modification #LB-000029B, laboratory blanks are to be analyzed at a frequency of 4%.

A total of 97 TEM laboratory blanks were analyzed by TEM during the time of the OU5 ABS programs (i.e., October 2007 to October 2008). No asbestos structures were observed in any laboratory blank sample. Based on these results, it is concluded that sample preparation and analysis procedures utilized within the analytical laboratories did not introduce asbestos contamination.

Recounts

A recount analysis is a re-examination of the original TEM grid openings to verify observed structure counts and characteristics. The following types of recount analyses were performed by each of the participating analytical laboratories during TEM analysis of ABS samples:

> *Recount Same (RS)* – This is a TEM grid that is re-examined (same grid openings) by the same microscopist who performed the initial examination.
>
> *Recount Different (RD)* – This is a TEM grid that is re-examined (same grid openings) by a different microscopist than who performed the initial examination.
>
> *Verified Analysis (VA)* – This is a recount of a TEM grid (same grid openings) performed in accord with the protocol for verified analysis as provided in NIST (1994).

Recount analyses were compared with the original analysis on a grid opening-by-grid opening and structure-by-structure basis. Only those grid openings that were able to be re-examined during the recount analysis were included in this evaluation. The degree of agreement (concordance) between the original analysis and the recount analysis was evaluated based on the total number of countable LA structures observed for each grid opening that was re-examined. Specific concordance criteria are detailed in Libby Laboratory Modification #LB-000029B.

A total of 11 *Recount Same*, 11 *Recount Different*, and 12 *Verified Analysis* have been performed as part of the OU5 ABS programs. For these analyses, a total of 342 grid openings have been re-examined as part of a recount analysis. Table E-5 summarizes concordance results for each grid opening that was re-examined. In this table, results that are concordant (i.e., the LA structure count reported for the grid opening in the original analysis matches the count reported in the recount analysis) are shaded in grey. As seen, concordance rates were good (100% agreement in total LA counts). These results show that LA structure counts by TEM are generally reproducible and that differences between TEM analysts are generally small and are not expected to influence the usability and interpretation of the ABS results.

Repreparations

A repreparation by TEM is a grid that is prepared from a new portion of the same field sample filter as was used to prepare the original grid. Repreparation analyses are compared to the original analysis based on the Poisson rate ratio method recommended by Nelson (1982).

Repreparations were prepared for 5 air samples as part of the OU5 ABS programs. Table E-6 summarizes the results of both the original analysis and the repreparation analysis. As seen, the total LA levels reported in the repreparation analysis were not statistically different from the original analysis for all samples. These results show that LA results are reproducible and that TEM analytical precision is not likely to be impacted by preparation methods.

4.3.2 PLM Analytical Laboratory QC

Laboratory Duplicates

For PLM-VE, a laboratory duplicate is a re-preparation of a soil sample slide by a different analyst (but within the same laboratory) than who performed the original analysis. Concordance between the laboratory duplicate analysis and the original analysis is evaluated using a methodology similar to that described above for field duplicates.

Table E-7 summarizes the original and laboratory duplicate results for PLM-VE. As seen, in all instances, both the original sample result and the laboratory duplicate result were ranked as concordant. These results support the conclusion that the soil sample results for PLM-VE are reproducible and reliable and are not greatly influenced by differences in laboratory analysis techniques between analysts.

Interlab Samples

For PLM-VE, an interlab analysis is performed by re-analysis of an independent aliquot of the original soil sample by an analyst from a different laboratory than who performed the initial analysis. The interlab analysis is blind to the interlab (i.e., the interlab cannot distinguish the interlab sample from other field samples on the field chain of custody form). Concordance between the interlab analysis and the original analysis is evaluated using a methodology similar to that described above for field duplicates.

Table E-8 summarizes the original and interlab results for samples collected as part of the OU5 ABS program. As seen, 23 out of 27 samples were concordant and 2 of 27 were weakly discordant, no samples were ranked as strongly discordant. These weak discordances may be due to analytical variability, or might arise from authentic small scale heterogeneity between soil aliquots drawn from the same sample bottle. These results support the conclusion that the soil sample results for PLM-VE are reproducible and reliable and are not greatly influenced by differences in analysis techniques across laboratories.

4.4 QC Conclusions

Based on the results of the QC evaluation, it is concluded that:

- Inadvertent contamination of air, dust, and soil field samples with LA is not of significant concern, either in the field or the laboratory.

- TEM precision is generally good, as indicated by high agreement rates between field samples and field replicates/duplicates, between original and re-preparation analyses, and between original and recount analyses (i.e., samples where the same grid openings are evaluated twice).

- PLM-VE precision is generally good, as indicated by high concordance rates between field samples and matched field duplicates, preparation splits, laboratory duplicates, and interlab samples.

- PLM-VE accuracy is also generally good, as indicated by the concordance rates when analyzing PE samples. When results were discordant, the laboratories tended to overestimate LA levels in soil compared to nominal levels (i.e., results were biased high).

5 Data Adequacy Evaluation

The following sections present a data adequacy evaluation to determine if available ABS air and soil data for OU5 are sufficient to allow risk managers to make informed decisions about potential risks to human health. This evaluation includes a comparison of the data collected with the specified data quality objectives (DQOs) stated in the respective ABS SAPs.

5.1 Moto-X Park ABS Samples

5.1.1 Sample Representativeness

The goal of the Moto-X Park ABS program (EPA 2008a) was to collect data which provide a reasonable representation of activities at the Moto-X Park that may result in exposures to LA in air. All ABS samples were collected from the Moto-X track during activities consistent with site use (e.g., during motorcycle use). Samples were collected in mid-September, during the part of the year when riding activities are expected to occur and when soil conditions are driest. Based on this, the Moto-X ABS data collected are deemed to be representative.

5.1.2 Sample Completeness

Completeness is defined as the fraction of samples that were planned that were successfully collected and analyzed. The Moto-X ABS SAP (EPA 2008a) recommended the collection of 24-32 personal air samples (6-8 individuals, 2 rides per person, on 2 different days) to characterize rider exposures and 10 stationary air samples to characterize spectator exposures. The Moto-X ABS program collected and analyzed 24 personal air samples and 10 stationary air samples.

The Moto-X ABS SAP also recommended the collection of a 30-point composite soil sample from the Moto-X track for analysis by PLM-VE. A single 30-point composite soil sample was collected from the Moto-X track at the time of the ABS sampling. At the time of collection, the field teams recorded estimated visual vermiculite levels at each sampling point. This sample was also analyzed by PLM-VE.

Thus, all air and soil samples specified in the SAP were successfully collected and analyzed (i.e., 100% completeness).

5.1.3 Analytical Sensitivity

As specified in the Moto-X ABS SAP (EPA 2008a), the target analytical sensitivity was 0.01 cc^{-1} for personal air monitors and 0.001 cc^{-1} for stationary air monitors. All personal air samples and most stationary air samples achieved the target analytical sensitivity. Three of the 10 stationary air samples achieved sensitivities slightly higher than the target, with values ranging from 0.0013 to 0.0015 cc^{-1}. The consequence of this is that the concentration estimates for these samples have somewhat higher uncertainty than would have been achieved if the samples had been analyzed until the analytical sensitivity was achieved. However, it is not expected that this leads to any bias in the data, so the overall impact on data quality is not expected to be significant.

5.2 Recreational Visitor ABS Samples

5.2.1 Sample Representativeness

The goal of the Recreational Visitor ABS program (EPA 2008c) was to collect data which provide a reasonable representation of recreational activities at the OU5 Site that may result in exposures to LA in air. All ABS air samples were collected from the recreational path along Libby Creek during activities consistent with site use (e.g., bicycle use). Sampling was conducted across the entirety of the recreational path, including both paved and unpaved sections. Samples were collected in mid-September, during the part of the year when recreational activities are expected to occur and when soil conditions are driest. Based on this, the Recreational Visitor ABS data collected are deemed to be representative.

5.2.2 Sample Completeness

The Recreational Visitor ABS SAP (EPA 2008c) recommended a minimum of 24 ABS air samples from each portion of the path (paved and unpaved) to represent adult exposures (3 individuals, 2 rides per day, 4 separate days). In addition, the SAP recommended the collection of 8 trailer ABS air samples from the paved path to represent child exposures (1 sample per ride, 2 rides per day, 4 separate days).

The Recreational Visitor ABS program collected and analyzed 21 personal air samples from each portion of the path (paved and unpaved) and 7 trailer air. Although the number of samples was slightly lower than the specified targets, because the underlying variability in these ABS air samples was generally small and concentrations were well below decision thresholds (see Section 7, Human Health Risk Assessment, of the OU5 Remedial Investigation Report), the number of ABS air samples collected is deemed adequate to support decision making.

5.2.3 Analytical Sensitivity

As specified in the Recreational Visitor ABS SAP (EPA 2008c), the target analytical sensitivity for all personal air samples was 0.006 cc^{-1}. All ABS air samples achieved the target analytical sensitivity (most samples achieved a lower sensitivity of 0.001 cc^{-1}).

5.3 Indoor Worker ABS Samples

5.3.1 Sample Representativeness

The goal of the Indoor Worker ABS program (EPA 2007) was to collect data which provide information on worker exposures inside buildings at the OU5 Site to determine if cleanup actions taken to date have reduced LA contamination to a level that is health-protective. For occupied OU5 buildings, ABS air samples were collected under disturbance scenarios that were representative of worker activities (both active and passive behavior conditions). For vacant OU5 buildings, ABS air samples were representative of a high-end disturbance scenario (following disturbance with a leaf-blower). Although it is likely that indoor air concentrations may vary over time, the focus of the ABS program was to estimate conservative (high-end) levels, so repeated sampling over time was not deemed necessary (EPA 2007).

5.3.2 Sample Completeness

The Indoor Worker ABS SAP (EPA 2007) recommended the collection of 5 stationary air samples from vacant buildings and a single 2-hour personal air sample for each disturbance scenario (active and passive behaviors) from occupied buildings. All buildings that were deemed “habitable” (i.e., having four exterior walls, a roof, and a floor that was not soil) were to be sampled.

A total of 20 buildings (13 vacant buildings and 7 occupied) were deemed “habitable” at the time of the ABS investigation (November/December 2007). Since this time, 2 vacant buildings originally sampled have either burned (plywood plant) or been demolished (log yard pump house). In addition, one vacant building (boundary injection building) that was originally within the OU5 boundary is outside the current boundary of OU5. For the remaining vacant buildings, a total of 50 stationary air samples (5 samples from each of 10 buildings[1]). For the occupied buildings, a total of 29 ABS samples were collected during active behaviors and 9 ABS samples were collected during passive behaviors. The number of active behavior samples collected is higher than expected because the 2-hour time interval was split across multiple samples (e.g.,

[1] One vacant building – the finger jointer processing plant – was not sampled.

collected at 30-minute or 60-minute intervals) to reduce the potential for particulate overloading on the filters. The number of passive behavior samples collected is higher than expected because activities conducted in the CDM office were separated into upstairs and downstairs.

Thus, with the exception of the finger jointer processing plant, all ABS air samples specified in the SAP were successfully collected and analyzed. Depending upon the future use of the finger jointer processing plant, measured ABS data may be needed for this building to inform risk management decisions.

5.3.3 Analytical Sensitivity

As specified in the Indoor Worker ABS SAP (EPA 2007), the target analytical sensitivity for all Indoor ABS air samples was 0.0005 cc^{-1}. All passive personal ABS air samples from occupied buildings achieved the target analytical sensitivity. For active personal ABS air samples, because multiple samples were collected across the 2-hour activity duration from each building, the adequacy of the achieved analytical sensitivity for these samples was evaluated based on the "pooled" sensitivity across samples, which was calculated as:

$$\text{Pooled Sensitivity } (cc^{-1}) = 1 \,/\, 3\ TAE_i\ (cc)$$

where:

TAE_i = Total amount of volume evaluated in sample analysis 'i' (cc). The TAE_i is equal to 1/sensitivity in analysis 'i'.

The pooled sensitivity across active ABS samples did not achieve the target sensitivity for 4 of the 8 occupied buildings. In addition, one or more stationary ABS air samples collected from 4 of the 10 vacant buildings also did not achieve the target sensitivity. When the target analytical sensitivity was not achieved, it was due to high particulate overloading on the filter which required indirect preparation, and high dilutions were typically necessary to achieve optimal grid loading (i.e., f-factors tended to be small). Thus, in most cases, the analysis was stopped because the maximum grid opening stopping rule was reached (i.e., 100 grid openings were evaluated).

As noted previously, the consequence of not achieving the target analytical sensitivity is that the air concentration estimates for these samples have somewhat higher uncertainty than if the samples had achieved the target analytical sensitivity. However, it is not expected that this leads to any bias in the data. Estimated risks to indoor workers were within EPA's acceptable risk range despite the elevated analytical sensitivities (see Section 7, Human Health Risk Assessment, of the OU5 Remedial Investigation Report). Thus, the available ABS air samples are deemed to be adequate to support decision making.

5.4 Outdoor Worker ABS Samples

5.4.1 Sample Representativeness

The goal of the Outdoor Worker ABS program (EPA 2008b) was to collect data which provide a reasonable representation of outdoor worker exposures during soil disturbance activities. Because it is not feasible to conduct outdoor ABS sampling on every acre of the OU5 Site, ABS was performed at eight 1-1.5 acre areas. These eight ABS areas were selected based on previous visible vermiculite sampling results to represent the range of expected soil contamination conditions at the OU5 Site, with Area 1 representing the low end of the soil range and Area 8 representing the high end of the range. At each ABS area, personal air samples were collected to represent two activities – raking and operating heavy machinery – which are considered to be general examples of relatively vigorous soil disturbances that may occur at the OU5 Site. Although it is likely that outdoor air concentrations may vary over time, the focus of the ABS program was to estimate conservative (high-end) levels during a time period when LA-releasability from soil was likely to be highest (i.e., during summer/fall) (EPA 2008b).

5.4.2 Sample Completeness

The Outdoor Worker ABS SAP (EPA 2008b) recommended the collection of a minimum of 4 personal air samples per ABS area (4 samples x 8 areas = 32 samples). As part of the Outdoor Worker ABS program, two workers wore personal air monitors while performing scripted raking and bobcat operation activities at each ABS area during 3 separate sampling events (2 workers x 8 areas x 3 events = 48 samples). A total of 6 ABS air samples per ABS area were collected and successfully analyzed (i.e., >100% completeness).

The Outdoor Worker ABS SAP also recommended the collection of a 30-point composite soil sample and 30 individual grab samples from each ABS area during each event for analysis by PLM-VE. All soil samples were successfully collected and visual vermiculite estimates were recorded for three 30-point composite samples (1 composite per event) and three sets of 30 grab samples (1 set of 30 grabs per event). Based on the preliminary PLM-VE results from Round 1, nearly all samples at all ABS areas were non-detect. Therefore, EPA decided to suspend the PLM-VE analysis of soil samples collected in Round 2 and 3 (see LFO-000141 for documentation of the suspension of analysis). A total of 16/24 composite samples (67%) and 445/720 grab samples (62%) were analyzed by PLM-VE. Visible vermiculite estimates were recorded for all soil sampling points during each event (100% completeness). Although only about ⅔ of the samples were analyzed by PLM-VE, comparisons of PLM-VE results to visible vermiculite estimates from other ABS programs suggest that visible vermiculite inspection results may be a somewhat more sensitive method for detecting contamination in soil than PLM-VE analysis of 30-point composite sample (EPA 2010). Therefore, the fact that not all soil samples were analyzed by PLM-VE is not deemed to be an important data limitation.

5.4.3 Analytical Sensitivity

As specified in the Outdoor Worker ABS SAP (EPA 2008b), the target analytical sensitivity for all outdoor worker ABS air samples was 0.001 cc^{-1}. The target analytical sensitivity was not achieved in 30 of 48 ABS air samples. As noted previously, the consequence of not achieving the target analytical sensitivity is that the air concentration estimates for these samples will have a higher degree of uncertainty. However, despite the fact that the target analytical sensitivity was not achieved for all individual samples, it is still possible for risk managers to make informed decisions for outdoor worker exposures. This is because the exposure point concentrations for outdoor workers used in the risk assessment are based on the average across ABS samples evaluating non-detects at zero. This approach yields an unbiased estimate of the true mean that does not depend on the analytical sensitivity of the samples included in the data set. Estimated risks to outdoor workers were within EPA's acceptable risk range despite the elevated analytical sensitivities (see Section 7, Human Health Risk Assessment, of the OU5 Remedial Investigation Report). Thus, the available ABS air samples are deemed to be adequate to support decision making.

5.5 Site-wide Surface Soil Samples

As described in the risk assessment (Section 7 of the OU5 Remedial Investigation Report), because it is not feasible to evaluate risks by conducting outdoor worker ABS sampling on every acre of the OU5 Site, it is necessary to draw risk conclusions about areas that have not been studied by ABS by assessing whether soil results from these areas are similar to the soil contamination levels in the Outdoor Worker ABS areas. Therefore, available soil samples must be representative of the entire OU5 Site and must have been sampled and analyzed using appropriate methods.

Outside of the ABS efforts, there have been three major site-wide surface soil sampling programs conducted at the OU5 Site. Each of these programs is described briefly below:

> **Contaminant Screening Study (October 2002):** As part of the Contaminant Screening Study (CSS), the OU5 Site was divided into seven sample collection areas based on land use – Former Popping Plant, Railroad Spur, Lumber Yard, Log Storage Area, Southwest Area, Former Champion Tree Nursery, and the Libby Groundwater Superfund Site. A total of 103 surface soil samples (generally 5-point composites) were collected from these areas in October 2002. All soil samples were analyzed by PLM-VE. At the time of sample collection, the field teams recorded qualitative information on the presence/absence of visible vermiculite for the soil sample in the field logbooks. Visible vermiculite was not reported in any soil sample collected (CDM 2007a). Only 2 surface soil samples had detectable levels of LA reported by PLM-VE – one sample from the former tree nursery and one sample from the southwest area near the Luck E G Post & Rail Company operations reported Bin B1 (trace) levels in soil.
>
> **OU5 Soil Data Gap Study, Part I (October 2007):** In October 2007, a second site-wide soil sampling program was conducted to address soil data gaps and further characterize areas with LA soil contamination at the OU5 Site (CDM 2007b). Sampling efforts focused on soil collection from the Libby Groundwater Superfund Site, the Former Champion Tree Nursery, the banks of Libby Creek, the Stormwater Containment/Waste Water Lagoon Area (an area which was not sampled during the CSS), and the Southwest Area (where trace levels were noted in the CSS). A total of 180 surface soil

samples (30-point composites) were collected from these areas and analyzed by PLM-VE. At the time of sample collection, the field teams recorded semi-quantitative visible vermiculite estimates at each soil sampling point in accord with SOP CDM-LIBBY-06. Detailed PLM-VE and visual vermiculite inspection results from this soil sampling program are summarized in CDM (2008a) *Sampling Summary Report – 2007 Investigations*.

OU5 Soil Data Gap Study, Part II (June/July 2008): During the analysis of the 2007 soil data gap samples, an additional data gap was identified for areas that were only sampled during the CSS in 2002 (CDM 2008b). Although CSS soil samples were available from these areas, the samples were not representative of more current collection protocols (i.e., samples were 5-point composite samples as opposed to 30-point composites and visual vermiculite information was only qualitative as opposed to semi-quantitative). Therefore, additional sampling was performed in June/July 2008 at the Moto-X Park, the Lumber Yard, the Southwest Area, the Railroad Spur, and the Log Storage Area. A total of 73 surface soil samples (30-point composites) were collected from these areas and analyzed by PLM-VE. At the time of sample collection, the field teams recorded semi-quantitative visible vermiculite estimates at each soil sampling point in accord with SOP CDM-LIBBY-06.

Figures 5.4 and 5.5 in the Remedial Investigation Report illustrate the site-wide soil contamination conditions at the OU5 Site based on PLM results and visual vermiculite inspection results, respectively. In interpreting these figures, it is important to remember that composite samples are representative of a larger area than the plotting point presented in the map. As seen, PLM-VE results and/or visible vermiculite information for soil is available for most of the OU5 Site. There are two general areas where soil data is not available:

- Within the Stormwater Containment and Waste Water Lagoon Area, large portions of this area were not sampled since they were forested areas and not expected to be used commercially (CDM 2008a). Measured soil data may be needed from these forested areas to characterize potential soil contamination depending upon the intended future land use.

- Within the Libby Superfund Groundwater Site, the Land Treatment Unit (LTU) cells were not sampled in October 2007 due to ongoing remedial activities (CDM 2008a). The Landfarm area was also not sampled in October 2007 because there was a concern that the clean top layer of soil could be contaminated by impacted subsurface soils during sampling (CDM 2008a). Subsurface soils from the Landfarm area were subsequently sampled in October 2008. A total of 51 grab samples (12-15 inches) were collected and analyzed by PLM-VE. All samples were reported as non-detect by PLM and visible vermiculite was only observed in one sample. The LTUs and Landfarm area are being remediated separately, as part of the Libby Superfund Groundwater Site.

6 DQA Conclusions

Taken together, these results indicate that air and soil data collected at the OU5 Site and utilized in this risk assessment generally are of acceptable quality, adequate and representative, and considered to be reliable and appropriate for use in the risk assessment.

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Table E-1. Impact Assessment for Field and Laboratory Modifications

Type	Number	Effective Date	Description	Impact on Data Evaluation
Field Mods	LFO-000134	9/8/2008	Specifies TEM analysis stopping rules in the Moto-X ABS SAP in terms of area examined rather than grid openings evaluated. Modification will standardize stopping rules across laboratories that may use grid openings of varying sizes.	None.
	LFO-000141	1/13/2009	Modifies the Moto-X ABS SAP and Outdoor Worker ABS SAP to incorporate a phased approach for the PLM and fluidized bed analysis of collected soil samples.	Although this modification reduces the number of soil samples analyzed, corresponding visual soil inspection and ABS air data indicate that soil contamination is fairly uniform and may not support a quantiative regression analysis.
	LFO-000145	5/11/2009	Modifies the number and types of soil samples that will be analyzed by the fluidized bed approach.	None.
Lab Mods	LB-000076	11/12/2007	Analysis of the ABS air samples in lab job EMSL 270701088 (L13120) was terminated at 100 grid openings rather than terminating at the target analytical sensitivity specified in the ABS SAP.	If 50 LA structures are recorded, then there is no impact on data quality. If counting is stopped at 100 GOs and structure count is low (e.g., <10), then there will be increased uncertainty in the estimates of concentration. However, there is no introduction of bias.
	LB-000081	11/26/2008	Analysis of the ABS air samples in lab job EMSL 040729249 (L13283) was terminated at 100 grid openings rather than terminating at the target analytical sensitivity specified in the ABS SAP.	
	LB-000077	10/30/2007	ABS Field Blanks - 30 grid opening stopping rule for all air and dust field blanks.	None.
	LB-000086	4/22/2008	All samples analyzed by SRC-Libby-03 (PLM-VE) shall be referenced by the use of a concatenation of the Index ID, Suffix ID, and the Suffix # (e.g. 1D-00827-FG2).	None.

Table E-2. Results of Air Field Replicates and Dust Field Duplicates Analyzed by TEM

Media	Original Sample												Field Duplicate Sample												Poisson Rate Comparison (95% CI)
	Index ID	Analysis Date	Lab Name	Analysis Method	Prep Method	EFA	Gox	GO Size	F Factor	Sens	N LA Struc	LA Conc (s/cc) or Loading (s/cm^2)	Index ID	Analysis Date	Lab Name	Analysis Method	Prep Method	EFA	Gox	GO Size	F Factor	Sens	N LA Struc	LA Conc (s/cc) or Loading (s/cm^2)	
Air	SL-00024	9/16/02	RESI	AHERA	DIRECT	385	4	0.011	1	0.0018	0	0	SL-00023	9/16/02	RESI	AHERA	DIRECT	385	4	0.011	1	0.0018	0	0	Both counts are 0; the rates are not different
	SL-00024	9/16/02	RESI	ISO	DIRECT	385	10	0.011	1	0.0007	0	0	SL-00023	9/16/02	RESI	ISO	DIRECT	385	10	0.011	1	0.0007	0	0	Both counts are 0; the rates are not different
	SL-00214	9/19/02	Mobile Lab	AHERA	DIRECT	385	4	0.0129	1	0.0034	0	0	SL-00213	9/19/02	Mobile Lab	AHERA	DIRECT	385	4	0.0129	1	0.0034	0	0	Both counts are 0; the rates are not different
	SL-00214	10/2/02	Westmont	ISO	DIRECT	385	10	0.0064	1	0.0028	0	0	SL-00213	10/2/02	Westmont	ISO	DIRECT	385	10	0.0064	1	0.0028	0	0	Both counts are 0; the rates are not different
	SL-00223	9/19/02	Mobile Lab	AHERA	DIRECT	385	4	0.0129	1	0.0025	0	0	SL-00222	9/19/02	Mobile Lab	AHERA	DIRECT	385	4	0.0129	1	0.0025	0	0	Both counts are 0; the rates are not different
	SL-00223	10/2/02	Westmont	ISO	DIRECT	385	10	0.0064	1	0.0021	0	0	SL-00222	10/2/02	Westmont	ISO	DIRECT	385	10	0.0064	1	0.0020	0	0	Both counts are 0; the rates are not different
Dust	SL-70653	1/23/08	Hygeia	ISO	INDIRECT	346	5	0.01	0.15	46.1	0	0	SL-70655	1/23/08	Hygeia	ISO	INDIRECT	346	5	0.01	0.15	46.1	0	0	Both counts are 0; the rates are not different
	SL-70497	12/28/07	RESI	ISO	INDIRECT	346	10	0.011	0.25	12.6	0	0	SL-70498	12/28/07	RESI	ISO	INDIRECT	346	10	0.011	0.5	6.3	1	6.3	[0-78] The rates are not different

Table E-3. Evaluation of Field Duplicates Analyzed by PLM-VE

		Field Duplicate Results			
		Bin A (ND)	Bin B1 (Tr)	Bin B2 (<1%)	Bin C (≥1%)
Original Sample Results	Bin A (ND)	35	1	0	0
	Bin B1 (Tr)	1	0	0	0
	Bin B2 (<1%)	0	0	0	0
	Bin C (≥1%)	0	0	0	0

	incl. ND	excl. ND
Total Pairs	37	2
Concordant	35 (94.6%)	0 (0%)
Weakly Discordant	2 (5.4%)	2 (100%)
Strongly Discordant	0 (0%)	0 (0%)

Table E-4. Evaluation of Preparation Split Analyzed by PLM-VE

		Preparation Split Results			
		Bin A (ND)	Bin B1 (Tr)	Bin B2 (<1%)	Bin C (≥1%)
Original Sample Results	Bin A (ND)	42	0	0	0
	Bin B1 (Tr)	0	0	0	0
	Bin B2 (<1%)	0	0	0	0
	Bin C (≥1%)	0	0	0	0

Total Pairs	42
Concordant	42 (100%)
Weakly Discordant	0 (0%)
Strongly Discordant	0 (0%)

Table E-5. Comparison of Number of Countable LA Structures Recorded in the Original Analysis and Recount Analysis

# of LA Structures in Unique GO		Recount Analysis Results			
		0	1	2	3
Original Analysis Results	0	326	0	0	0
	1	0	15	0	0
	2	0	0	0	0
	3	0	0	0	1

Total Pairs	342
Match	342 (100%)
Off by 1 Structure	0 (0%)
Off by >1 Structure	0 (0%)

Table E-6. TEM Repreparation Results for Air

Analysis Details			Original Analysis Results						Repreparation Analysis Results						Poisson Rate Comparison (95% CI)
Index ID	Analysis Method	Prep Method	AnalysisIDSeqN	Lab Name	Analysis Date	N LA Struc	Sensitivity	Total LA Conc/ Loading	AnalysisIDSeqN	Lab Name	Analysis Date	N LA Struc	Sensitivity	Total LA Conc/ Loading	
SL-00038	TEM-ISO10312	DIRECT	33027	RESI	9/16/2002	0	--	0.0E+00	33018	RESI	9/17/2002	0	--	0.0E+00	Both counts are 0; the rates are not different
SL-00159	TEM-ISO10312	DIRECT	33974	Hygeia	10/2/2002	0	1.4E-02	0.0E+00	34862	Hygeia	10/12/2002	0	1.4E-02	0.0E+00	Both counts are 0; the rates are not different
SL-00300	TEM-ISO10312	DIRECT	185204	Mobile Lab	11/3/2008	0	9.6E-04	0.0E+00	187175	Mobile Lab	12/1/2008	0	1.7E-03	0.0E+00	Both counts are 0; the rates are not different
SL-00399	TEM-ISO10312	DIRECT	182724	RESI	10/6/2008	0	9.1E-04	0.0E+00	182725	RESI	10/7/2008	1	8.8E-04	8.8E-04	[0-40.42] The rates are not different
SL-70787	TEM-ISO10312	DIRECT	179270	MAS	7/31/2008	0	5.0E-03	0.0E+00	179271	MAS	7/31/2008	0	4.9E-03	0.0E+00	Both counts are 0; the rates are not different

Table E-7. Evaluation of Laboratory Duplicates Analyzed by PLM-VE

Cross-Check

		Laboratory Duplicate Results			
		Bin A (ND)	Bin B1 (Tr)	Bin B2 (<1%)	Bin C (≥1%)
Original Sample Results	Bin A (ND)	64	0	0	0
	Bin B1 (Tr)	0	4	0	0
	Bin B2 (<1%)	0	0	0	0
	Bin C (≥1%)	0	0	0	0

	incl. ND	excl. ND
Total Pairs	68	4
Concordant	68 (100%)	4 (100%)
Weakly Discordant	0 (0%)	0 (0%)
Strongly Discordant	0 (0%)	0 (0%)

Self-Check

		Laboratory Duplicate Results			
		Bin A (ND)	Bin B1 (Tr)	Bin B2 (<1%)	Bin C (≥1%)
Original Sample Results	Bin A (ND)	58	0	0	0
	Bin B1 (Tr)	0	0	0	0
	Bin B2 (<1%)	0	0	0	0
	Bin C (≥1%)	0	0	0	0

	incl. ND
Total Pairs	58
Concordant	58 (100%)
Weakly Discordant	0 (0%)
Strongly Discordant	0 (0%)

Table E-8.
Comparison of Interlabs Analyzed by PLM-VE

		Interlab Results			
		Bin A (ND)	Bin B1 (Tr)	Bin B2 (<1%)	Bin C (≥1%)
Original Sample Results	Bin A (ND)	22	1	0	0
	Bin B1 (Tr)	3	1	0	0
	Bin B2 (<1%)	0	0	0	0
	Bin C (≥1%)	0	0	0	0

	incl. ND	excl. ND
Total Pairs	27	5
Concordant	23 (85.2%)	1 (20%)
Weakly Discordant	4 (14.8%)	4 (80%)
Strongly Discordant	0 (0%)	0 (0%)

TEM CONSISTENCY REVIEW AND DATA TRANSFER VERIFICATION REPORT

Date: April 20, 2010 Prepared by: Natalie Ross

Validation of OU5 ABS Samples

SUMMARY OF FINDINGS AND DATA QUALITY IMPLICATIONS

There were two findings that involve the incorrect transfer of data from the hardcopy report to the EDD. These issues include one instance of a structure length incorrectly entered in the EDD and one instance where the photo reference number was incorrect. There were two analyses that have duplicate entries in the database; a corrected EDD was uploaded to the database but the original EDD was not removed. In one analysis, the structure lengths were rounded up in the database and do not match the bench sheet. For example, the structure length written on the bench sheet is 0.05 but is rounded up to 0.1 in the database. In each instance, the mineral class for the structures was chrysotile so it does not impact calculations based on LA structures.

There were two analyses where the analyst was inconsistent in recording complex structures on the bench sheet and recorded dimensions of the entire matrix on the primary structure line. The primary structures were recorded on the bench sheet but not transferred to the EDD; the secondary structures were correctly recorded on the bench sheet and transferred to the EDD. In these cases, the laboratory should cross out the primary structure information (including length, width, identification and mineral class) on the bench sheet and initial. These issues were previously identified by Anni Autio on 4/4/2010.

One analysis was not originally selected for validation, however, after a general review for consistency in the database, there were two grid opening names that appeared to be incorrect so the analysis was selected for validation. In addition to the grid opening name errors for this analysis, there was one instance where the mineral class was unclear. It looks like a “1” is entered in the chrysotile box on the bench sheet, but the EDD has this structure identified as LA. The laboratory should verify the correct mineral class.

Recommendations for future review and verification:

The error rates in the validation were low and the issues found were not critical and did not impact the calculations for LA structures. Therefore, future validation is not needed.

TEM-ISO 10312 SELECTION AND CONSISTENCY REVIEW RESULTS

Summary of available analyses for samples specified –

Analyst, Laboratory	Number of TEM-ISO 10312 Analyses			Number of Analyses Selected for Review		
	Detect	Non-Detect	Total	Detect	Non-Detect	Total
J. XU, Batta	7	7	14	2	1	3
K. Corbin, Hygeia	2	0	2	1	0	1
Q. Trieu, Hygeia	9	1	10	2	1	3
A. Keeton, MAS	3	6	9	1	1	2
K. Simpson, MAS	3	1	4	1	1	2
M. Motamedi, MAS	3	11	14	1	1	2
R. Mahoney, EMSL	7	46	53	2	4	6
R. Pescador, EMSL	13	59	72	3	5	8
A. Heitger, Resi	6	3	9	1	1	2
N. DelHierro, Resi	3	1	4	1	1	2
N. Zimbelman, Resi	26	36	62	6	3	9
G. Agnello, Westmont	2	1	3	1	1	2
Total	84	172	256	22	20	42

	Goal	Actual
Selected Total	26	42*
Selected Detects	13	22
Selected Non-Detects	13	20

*Note: Analysis SL-00397 was not included in the original selection but added after errors were found in the database

Detailed summary of bench sheet consistency review –

Number of analyses reviewed: 42 (10 % of total analyses selected)

Number of analyses with recording and data transfer issues identified: 8 (19% of total analyses reviewed)

Types of recording and data transfer issues identified (indicate the number of analyses):

_______ Reported structure types are inconsistent with ISO guidance

_______ Primary and/or total columns are not populated correctly

_______ NAM structures are recorded and not identified as non-countable

_______ Fibers recorded as countable do not meet aspect ratio criteria (LB-000016)

1 Mineral class designation is missing or inconsistent

_______ Structure comments are inconsistent with LB-000066

1 Structure comments are inconsistent with recorded data

4 Structure attributes in the database do not match the bench sheet

2 Duplicate entries in database

2 Incorrect grid opening name

Do the recording issues identified appear to be associated with a particular analyst or laboratory? Yes No

If yes, identify the analyst and/or laboratory: ____

____

ISSUE RESOLUTION AND STATUS

Requested revisions for recording and data transfer issues were sent to Amy Christensen at ESAT on 4/20/2010. A summary of the requested revisions can be found in Table 1 below.

Table 1. Requested Revisions for OU5 ABS Samples

Sample ID	Unique Grid Opening	Laboratory Name	Laboratory Job Number	SRC Comments	Database Revision	EDD/Benchsheet Revision
SL-00430	1_A2, 1_G7	Batta	CDM-152	Length, width, identification and mineral class for GOs 1_A2 (MD11) and 1_G7 (MD10) should be crossed out and initialed for the primary structures on benchsheet.		x
SL-00431	1_C10	Batta	CDM-152	Length, width and identification for GO 1_C10 (MD10) should be crossed out and initialed for the primary structures on benchsheet.		x
SL-70433	Multiple	MAS	M45425	In 11 GOs, the length has been rounded in the database. For example, GO CI_G1, the length written on the benchsheet is 0.05 but is rounded to 0.1 in the database. The EDD needs to be reloaded into the database.	x	x
SL-70361	2_E9	Mobile Lab	270701205	Photo should be #04440 not #0440 in the EDD.		x
SL-70376	Multiple	Mobile Lab	270800036	Result information in the database is duplicated; both the original submitted EDD and the corrected EDD from 4/1/09 are in the database.	x	
SL-70561	Multiple	Mobile Lab	270800036	Result information in the database is duplicated; both the original submitted EDD and the corrected EDD from 4/1/09 are in the database.	x	
SL-00397	A_A5-4 A_A5-1 B_B2-6	RESI	161814	GO name in database should be A_A5-4 not A_39577 GO name in database should be A_A5-1 not A_39574 Mineral class for GO B_B2-6 is unclear, need laboratory to clarify. It looks like a "1" is entered in the Chrysotile box, but the EDD has this structure identified as LA.		x
SL-70683	A_F2-3	RESI	148479	Length should be 9 not 7 in the EDD.		x

PLM CONSISTENCY REVIEW AND DATA TRANSFER VERIFICATION REPORT

Date: July 28, 2010 Prepared by: Natalie Ross

SUMMARY OF FINDINGS AND DATA QUALITY IMPLICATIONS

The data verification identified errors in the reported PLM-VE bin for two soil samples. One analysis was not originally selected for validation, however, after a review of an analysis from the same laboratory job it became apparent that the results for the two samples were incorrectly entered in the EDD.

There were also several findings that involve the incorrect transfer of data from the hard copy report to the EDD. These issues include transfer errors of the analyst name, analysis date and laboratory job number. In several analyses, the laboratory inconsistently reported the Lab QA type on the bench sheet and recorded “LD” for both “Not QA” and “LD” samples. The laboratory should verify the correct QA Type and make revisions on the bench sheet.

Recommendations for future review and verification: The error rates in the validation were low and the issues found were not critical. Therefore, future validation is not needed.

PLM SELECTION AND CONSISTENCY REVIEW RESULTS

Summary of available analyses for samples specified –

Analyst, Lab	Number of PLM Analyses			Number of Analyses Selected for Review		
	Detect	Non-Detect (Bin A)	Total	Detect	Non-Detect (Bin A)	Total
AK, Batta	0	71	71	0	4	4
JT, Batta	1	47	48	1	3	4
Douglas Kent, ESAT	5	9	14	4	1	5
Nikki McDonald, ESAT	21	20	41	18	1	19
Talena Oliver, ESAT	4	14	18	3	1	4
A. Casas, Hygeia	0	16	16	0	1	1
F. Guiierrez, Hygeia	0	1	1	0	1	1
G. Hernandez, Hygeia	2	130	133	2	7	9
H. Espinoza, Hygeia	0	1	1	0	1	1
Derrill Duncan, MAS	0	26	26	0	1	1
Kevin Simpson, MAS	0	11	11	0	1	1
PMHess, MAS	0	34	34	0	2	2
WB Egeland, MAS	0	62	62	0	3	3
Mobile Lab	5	17	22	4	1	5
LW, RESI	0	2	2	0	1	1
NRA, RESI	0	1	1	0	1	1
PDL, RESI	0	1	1	0	1	1
PFK, RESI	0	1	1	0	1	1
RSW, RESI	21	461	480	18	25	43
D. Beard, Westmont	0	1	2	0	1	1
Total	59	926	985	50	58	108

	Goal	Actual
Selected Total	99	108*
Selected Detects	50	50
Selected Non-Detects	50	58

*Note: Analysis SL-70071 was not included in the original selection but added after errors were found in another analysis

Detailed summary of bench sheet consistency review –

Number of analyses reviewed: 108 (10% of total analyses selected)

If not all analyses could be reviewed, provide a brief explanation for why: N/A

Number of analyses with recording and data transfer issues identified: 16 (15% of total analyses reviewed)

Types of recording issues identified (indicate the number of analyses):

___7____ Incorrect/missing information on analysis details (e.g., lab job number, analysis date)

_________ Reported value does not use correct binning category.

Data Transfer issues identified:

___7____ Incorrect/missing information on analysis details (e.g., lab job number, analysis date)

___2____ Reported value does not use correct binning category.

Do the recording or data transfer issues identified appear to be associated with a particular analyst or laboratory?

Yes No

If yes, identify the analyst and/or laboratory: ____

ISSUE RESOLUTION AND STATUS

A summary of the EDD/bench sheet revisions can be found in Table 1 below.

Table 1. Requested Revisions for OU5 ABS Samples

Sample ID	Laboratory Name	Laboratory Job Number	SRC Notes
2R-05230 2R-05282 2R-05283	Mobile Lab	270900114	Analyst name written on the bench sheet but not entered in the EDD
1-09011 1-09013	Mobile Lab	270900476	Analyst name written on the bench sheet but not entered in the EDD
CS-09300	Reservoirs Environmental Services	102783	QA Type on bench sheet does not match the EDD.
CS-09596	Reservoirs Environmental Services	102783	QA Type on bench sheet does not match the EDD.
CS-09705	Reservoirs Environmental Services	103573	Analysis date on bench sheet (4/10/2004) does not match the date in the EDD (4/9/2004)
CS-18489	Reservoirs Environmental Services	105080	QA Type on bench sheet does not match the EDD.
CS-18583	Reservoirs Environmental Services	107324	QA Type on bench sheet does not match the EDD.
SL-70071	Reservoirs Environmental Services	146149	Reported value should be "1" not "ND"
SL-70072	Reservoirs Environmental Services	146149	Reported value should be "ND" not "1"
SL-70295	Reservoirs Environmental Services	148239	QA Type on bench sheet does not match the EDD.
SL-70335	Reservoirs Environmental Services	149474	QA Type on bench sheet does not match the EDD.
SL-00634	Reservoirs Environmental Services	164190	QA Type on bench sheet does not match the EDD.
SL-70057	Westmont	40809060	Laboratory job number on bench sheet is written as both 04080960 and 040809060

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Remedial Investigation Report

HDR

Operable Unit 5
Libby Asbestos National Priorities List Site

September 2010

EPA United States Environmental Protection Agency
"...to protect human health and to safeguard the natural environment..."